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

Bridge Number: 4190

Executive Summary

Bridge 4190 (Fort Snelling-Mendota Bridge) carries vehicular traffic on Trunk Highway 55 across the Minnesota River valley between Mendota Heights, Dakota County, and the Fort Snelling area of Hennepin County. It has an overall structure length of 4,113.4 feet and an out-out width of 92 feet. With 13 rib-arch main spans of 304 feet each, it was the longest, continuous, concrete-arch bridge in the world when built in 1926. It represents the work of two important Minnesota engineers, Walter Hall Wheeler and C.A.P. Turner. A major rehabilitation in 1992 replaced the deck and reconstructed the pedestrian railings. The bridge is in Fort Snelling State Park and the Fort Snelling Historic District (state and National Historic Landmark). The east end is adjacent to the Mendota Historic District (National Register).

Bridge 4190 is generally in good condition. It has excellent load capacity, adequate deck width, and FHWA-compliant vehicular barriers and median as a result of a 1992 rehabilitation project. The primary concern is the deterioration of the concrete and steel components of the ornamental pedestrian railings, which were reconstructed in 1992, found on both sides of the bridge.

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.

MEAD & HUNT HNTB JUNE 2006

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I - Project Introduction — Bridge Number: 4190

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.

II - Bridge Data — Bridge Number: 4190

Date of Construction	1926		
SHPO Inventory Number	DK-MHC-002		
Common Name (if any)	Fort Snelling-Mendota Bridge		

Location

Feature Carried:		TH 55	
Feature Crossed:		Minnesota River, railroad, street, state park	
Descriptive Location:		0.5 Miles Southeast of Jct. TH 5	
UTM Zone:	15	NAD:	1927
Easting:	485500	Northing:	4970640
USGS Quad Name:		St. Paul West	
Town or City:		Mendota Heights	
County:		Dakota	

Structure Data

Main Span Type: 211 Concrete Continuous Arch - Deck Total Length: 4113

Descriptive Information (or narrative as available)

Superstructure:

Substructure:

Floor/Deck:

Other Features:

Narrative:

Bridge 4190 is located at the Minnesota River crossing of State Trunk Highway 55, 0.5 miles southeast of the junction of State Trunk Highway 5 and 1.7 miles above the river's mouth. The bridge joins Dakota County with Hennepin County at the municipality of Mendota Heights (Dakota County) supplying direct access to the Twin Cities for the residents of Scott, Dakota, and Rice counties, although this function has since been partially negated by the construction of the Mississippi River Bridge at Interstate 35E.

It was built in 1926 and reconditioned in 1968. The spandrels, deck, and railings were reconstructed during a 1992 deck widening. The arch ribs and piers were not altered.

According to the Minnesota Department of Transportation Structure Inventory Report, Bridge 4190 is a steel reinforced continuous-arch concrete bridge consisting of 13 spans in the main unit and 6 spans in the approach units for a total length of 4,113.4 feet and a maximum span length of 304 feet. The 13 main-unit spans rest on 12 piers placed 304 feet apart, anchored 70 feet beneath the bed of the river. The navigable vertical clearance is 120 feet. The deck width (out-out) is 92 feet with a center median and two 35.5-foot roadways, each carrying two lanes of one-way traffic, and an 8-foot-wide north sidewalk and 4-foot-wide south sidewalk. The sidewalks are separated from the traffic lanes by vehicular railings. In American Building, Carl Condit described the Mendota Bridge as being “divided into twelve (sic) spans of paired parabolic ribs” (p. 255).

Some piers of this bridge, along with the west approach, are within the boundary of the Fort Snelling Historic District (state and National Historic Landmark). The east end is adjacent to the Mendota Historic District (National Register).

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

Contractor

Designer/Engineer Walter Hall Wheeler
C.A.P. Turner Company Associates

Significance Statement

The Mendota Bridge is nationally significant for its superb design and for the fact that at the time of construction it was the longest continuous concrete arch bridge in the world. It is one of the most prominent of the Twin Cities' nationally renowned concrete arch bridges of the 1920s.

Two prominent American bridge authorities, Carl Condit and David Plowden, have recognized the significance of the Twin Cities' concrete bridges and the Mendota Bridge in particular. As Plowden points out, "the first really sophisticated American program of concrete highway bridge construction evolved around Minnesota's Twin Cities." This happened, says Condit, because here "the Mississippi and Minnesota Rivers offered the engineers numerous opportunities to try their ingenuity."

The bridge was built in 1925-26 to replace an antiqued ferry which since the mid-nineteenth century had provided the only Minnesota River crossing between Fort Snelling in Hennepin County and Mendota in Dakota County. It was constructed according to the plans of Minneapolis engineer Walter H. Wheeler and nationally prominent engineer C.A.P. Turner Company Associates, and officially opened on November 8, 1926, amidst great fanfare. A parade and two huge caravans of an estimated 15,000 automobiles met at the middle of the bridge where the governor untied formal golden ropes. The occasion was marked by a telegram from President Calvin Coolidge acknowledging the bridge's dedication to the "Gopher Gunners" of the 151st Field Artillery who died in World War I.

The $1,870,000 structure, Plowden stated, "is usually considered to be the most sophisticated design for a concrete arch built in the 1920's," apart from some of the West Coast bridges. Condit wrote that "the whole complex of ribs, spandrel posts, and long deck has a finely articulated quality that has seldom been matched in American bridge design."

Historic Context Reinforced-Concrete Highway Bridges in Minnesota

National Register Criteria C

References

Historical information provided by Mn/DOT; Robert M. Frame, "Fort Snelling-Mendota Bridge," National Register of Historic Places form, in State Historic Preservation Office, Minnesota Historical Society, St. Paul; Condit, Carl W. American Building. Chicago: University of Chicago Press, 1968; David Plowden, Bridges: The Spans of North America (New York: WW Norton & Co., 1974); William H. DeButts, "Novel Methods Used in Building Long Concrete Arch Bridge," Engineering News-Record 97 (October 14, 1927), 621-623; Walter H. Wheeler, "Long Concrete-Arch Road Bridge Over Minnesota River," Engineering News-Record 98 (March 31, 1927), 514-519.

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. Reinforced-concrete rib arches. The 13 spans of reinforced-concrete, continuous rib-arches made Bridge 4190 the longest, continuous, concrete-arch bridge in the world at the time of construction in 1926. The arch configuration also has been recognized for its overall aesthetic qualities.

Feature 2. Ornamental railing. Although the bridge is characterized by a simplicity of form with little ornament, the railing is a significant aesthetic feature. The combination of metal panels and concrete posts constitutes almost two linear miles of ornamental railing. When the deck was replaced and widened in 1992, the original steel railing panels were reinstalled with new concrete behind an inner, crash-tested, vehicular barrier. This feature includes two bronze dedication plaques on concrete endposts.

IV - Engineering Data

Bridge Number: 4190

(Inspection and inventory data in this section was provided for this project by Mn/DOT in May 2005)

Inspection Date	7/15/2004
Sufficiency Rating [1]	85.7
Operating Rating [1,2]	48.07
Inventory Rating [1,2]	29.02
Posted Load [1]	0
Design Load [1]	9
Deficiency Rating Status [1]	A
Condition Codes	
Deck:	7
Superstructure:	7
Substructure:	7
Channel and Prot.:	7
Culvert:	n
Appraisal Ratings	
Struct. Eval.:	7
Deck Geometery:	7
Underclearances:	9
Waterway Adequacy:	7
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 4190 and determined it to be stable for the calculated scour conditions. The calculated scour depth from the scour prediction equations is within the limits of the footings or piles.
Roadway Data	
ADT Total:	39000
Truck ADT Percentage:	4
Bypass Detour Length [2]:	4.8279
Roadway Clearances	
Roadway Width [2]:	21.6408
Vert. Clearance Over Rdwy [2]:	99.99
Vert. Clearance Under Rdwy [2]:	5.42544
Lat. Under Clearance Right [2]:	6.46176
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 4190 will not inundate during a Q100 flood event.

Accident Data

The Mn/DOT Accident Database reports 49 accidents associated with this bridge for the 15-year period of 1990-2004.

34 – Property Damage – No Apparent Injury accidents
10 – Injury – Possible Injury accidents
4 – Injury – Non-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 4190 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 4190 carries a large volume of traffic. The 2004 ADT is 42,500 vehicles. The deck is configured with a median flanked by two 35.5-foot-wide roadways. Each roadway carries two lanes of traffic. The desired width for a two-lane bridge with one-way traffic is 36 feet. Because the sidewalks can provide safe haven for stranded motorists, the 35.5-foot wide roadways appear adequate.

Bridge 4190 has excellent load-carrying capacity. The ratings on the inventory report are based on an evaluation of the slab (HS 32 inventory, HS 53 operating) and are well above the desired value of HS 25.

Structural Condition Observations:

There are longitudinal cracks on the bottom of the deck over both arch ribs in most spans. Mn/DOT inspectors note longitudinal cracking on the top of the deck for the full length of the deck. Isolated map cracking in the top of the deck was also noted in the inspection report .

The concrete vehicular railings and median appear in excellent condition.

The concrete and steel components of the ornamental pedestrian railings have modest deterioration in most locations (rust staining from connections, discolored concrete, grout pop-outs). In isolated locations, the deterioration is advanced for a railing reconstructed in 1992 with significant scaling and spalling. The sides of railing elements exposed to snow-plowing operations are in poorer condition than others, due to contact with salt laden snow and minor impact damage.

The ornamental railing contains details where rectangular, cast-steel panels are embedded in a concrete base. The extended interface between the two materials appears to be a common location for accelerated deterioration.

Non-Structural Observations:

There is graffiti on both ends of the bridge on substructure components (primarily the abutments). Most of the graffiti on the west end has been painted over. Extensive graffiti remains on the east substructure units.

Localized ponding on both sidewalks was observed during the site visit. The galvanized steel drainage components appear in good condition.

Construction debris (bits of concrete, fine and coarse aggregate) has collected on both abutment bridge seats. The debris may be the result of 1992 construction activities or subsequent replacement of expansion joint glands.

Date of Site Visit

September 8, 2005

Figure 1. Looking east along the north side of bridge. Components below the deck appear in excellent condition.

Figure 2. Looking west from the north sidewalk near the middle of the bridge. The vehicular barriers appear in excellent condition. Localized ponding of water is evident on both sidewalks.

Figure 3. Isolated instances of map cracking appear in the deck. Longitudinal cracks in the deck are noted in the inspection report.

Figure 4. Deteriorated concrete appears in the north ornamental railing. The extensive level of deterioration visible here is not typical. However, form-tie popouts, cracking, and small spalls are typical.

Figure 5. Deteriorated concrete and steel components in the south ornamental railing. Rust staining and scaling are more prevalent on surfaces subject to snowplow spray.

Figure 6. Arch ribs and foundation components appear in excellent condition.

Figure 7. Graffiti and concreted rip rap at the east abutment. Debris on the bridge seats of both abutments appears to be the result of past failure of expansion joint glands.

Figure 8. Longitudinal cracking in the deck over both arch ribs is typical. The galvanized drainage system components appear in good condition.

Overall Recommendations

As a result of a major rehabilitation project in 1992, Bridge 4190 has adequate deck width, excellent load capacity, and FHWA-compliant railings. Therefore, the bridge is well-suited for continued vehicular use on-site. Due to deterioration, the ornamental pedestrian railing requires repair or reconstruction as determined through materials testing and analysis of reasons for early failure. Other less-desirable preservation options were not considered.

Recommended Future Use:

Rehabilitation for continued vehicular use on-site.

Recommended Stabilization Activities:

1. Seal the cracks on the top of the deck to minimize the intrusion of salt-laden water. Utilize standard Mn/DOT crack sealing procedures.

2. Provide penetrating sealers or durable polymeric coating, such as epoxy, on the sidewalks to minimize the intrusion of salt-laden water. Continue the coating two inches up the vertical faces of adjacent concrete barriers. The coating may require the incorporation of grit or sand to provide a surface with adequate roughness to prevent slipping by pedestrians. The color of the coating should match the existing concrete.

3. Spot paint the steel components of the ornamental pedestrian railing using standard Mn/DOT procedures to arrest corrosion.

Recommended Preservation Activities:

1. Remove the graffiti at both ends of the bridge.

2. Remove debris from the abutment seats.

3. Conduct a study to determine the cause of the longitudinal cracking in the deck. Possible causes include: restraint caused by the deck and shrinkage, a faulty reinforcing detail, temperature effects, or heavy vehicular loading. Seal cracks using bonding crack sealers, such as low viscosity epoxy or methylmethacrylate.

4. Conduct material testing of the existing ornamental railing's steel and concrete components. Determine the typical paint system characteristics and the reasons for the early failure of the paint system. Determine the characteristics of the different concretes and grouts used in the ornamental railing. Identify the reasons for the early failure of these components. Determine the level of chloride intrusion into the concrete elements.

5. Prepare construction documents and material specifications for the ornamental railing that can be used to repair the railing when warranted or to reconstruct the entire railing. For programming purposes, it is assumed that the railing needs to be reconstructed.

Projected Inspections to Monitor Bridge Condition

Routine:

1. Routine annual inspections are recommended. Perform recommended maintenance activities identified during 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 during 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, median, sidewalks, and railings with water annually.

2. Spot-paint steel components of the ornamental railing using standard Mn/DOT procedures on a 5-year cycle.

3. Recoat the sidewalks with a durable polymeric coating, such as epoxy, on a 20-year cycle.

4. Map cracking of the concrete overlay may indicate a need to replace the concrete overlay within the 20-year planning window for this management plan. Use standard Mn/DOT practices for low-slump concrete overlays.

5. Seal deck cracks on a 5-year cycle to limit the intrusion of salt-laden water into the deck.

VI - Projected Agency Costs Bridge Number: 4190

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: $302,800 annualized

Stabilization activities
Superstructure: $0
Substructure: $0
Railing: $85,000
Deck: $250,000
Other: $150,000
Total: $485,000

Preservation activities
Superstructure: $0
Substructure: $5,500
Railing: $1,200,000
Deck: $0
Other: $110,000
Contingency: $301,000
Total: $1,616,500

Note: The preservation activities costs include reconstruction of the ornamental pedestrian railing. Following the testing and engineering activities associated with the railing, decisions concerning repair or reconstruction can be made.

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: 4190 **TH 55 OVER MINN RIVER, RR, STREET** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No.	(RS 1) - 1
District	05
Maint. Area	5A
County	19 DAKOTA (37)
City	2535 MENDOTA HEIGHTS
Township	
Placecode	41696
Desc. Loc.	0.5 MI SE OF JCT TH 5
Sect.	28
Tnsp.	028N
Range	23W
Lat.	44d 53m 05s
UTM-Y	4970185.85
Long.	93d 10m 25s
UTM-X	486280.70
Toll Bridge (Road)	NO
Custodian	STATE
Owner	STATE
Inspector	METRO DISTRICT
BMU Agreement No	
Year Built	1926
Yr Fed Rehab	1992
Year Remod.	1992
Temp.	
Skew	0
Plan Avail.	CENTRAL

* STRUCTURE DATA *

Service On	HWY;PED
Service Under	HWY;RR;STREAM
MN Main Span	212 CONC CNT/ARCH
MN MSpn Det Def	OPEN SPANDREL ARCH
MN Appr. Span	109 CONC/SLAB SPAN
MN ASpn Det Def	
Culvert Type	
Barrel Length	
No. Main Spans	13
No. Appr.Span	6
Total Spans	19
NBI Len. (?)	YES
Main Span Length	304.0 ft
Structure Length	4,113.4 ft
Abut. Mat'l.	CONCRETE
Abut. Fnd. Type	SPRD/ROCK
Pier Mat'l.	CONCRETE
Pier Fnd. Type	SPRD/ROCK
Deck Width	92.0 ft
Deck Material	CIP CONC
Wear Surf. Type	LO SLP CON
Wear Surf. Inst. Yr.	1992
Wr. Crs/Fill Depth	0.16 ft
Deck Membrane	NONE
Deck Rebars	EPOXY REBAR
Deck Rebars Inst. Yr.	1992
Structure Area	378,433 sq ft
Roadway Area	292,047 sq ft
Swk Width L/R	8.0 ft 4.0 ft
Curb Ht. L/R	
Rail L/R/FHWA	22 22 YES
Ped. Fencing	
Hist. Significance	NATL REGISTER
Bird Nests (?)	NO

* ROADWAY DATA *

Route System (Fed)	MNTH
Mn. Route System	MNTH
Route Number	55
Roadway Name	TH 55
Roadway Function	MAINLINE
Roadway Type	2 WAY TRAF
Control Section	1909
BDG. Reference Point	198+00.617
Date Opened to Traffic	10-01-1994
Detour Length	3 mi
Lanes	4 ON BRIDGE (1)
ADT	42,500
HCADT	1700
ADT Year	2004
Functional Class	URB/PR ART FRWY
Nat'l. Hwy. System	NHS
STRAHNET	NOT STRAHNET
Truck Net	TRUCKNET
Fed. Lands Hwy.	N/A
OnBaseNet	ON BASENET

* ROADWAY CLEARANCES *

	If Divided NB-EB	SB-WB
Rdwy. Wid. Rd 1/Rd 2	35.5 ft	35.5 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	40.0 ft
Appr. Surface Width	73.0 ft	
Median Width	2.0 ft	

* ROADWAY TIS DATA *

	TIS 1st KEY	TIS 2nd KEY
Route System	03	
Route Number	00000055	
High End	2,06	
Low End	2,06	
Direction	S	
Reference Pt.	198+00.617	
Interchg. Elem.		

* MISC. BRIDGE DATA *

Struct. Flared	
Parallel Struct.	NONE
Field Conn. ID	
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	NOT APPL

Def. Status ADEQ **Suff. Rating** 85.7

* WATERWAY DATA *

Drng. Area	
Wtrwy. Opening	99,999 sq ft
Navigation Control	PERM REQD
Nav. Vert./Hrz Clr.	100.0 ft 220.0 ft
Nav. Vert. Lift Clr.	
MN Scour Code	N-STBL;LIM SCOUR
Scour Eval. Year	1993

* INSPECTION DATA *

Inspection Date	08-08-2005 (JTAM)
Inspection Frequency	24
Inspector	METRO

Condition Codes		**Appraisal Ratings**	
Deck	7	**Struct. Eval.**	7
Superstruct.	7	**Deck Geometry**	7
Substruct.	7	**Underclearances**	9
Chan. & Prot.	7	**Waterway Adeq'cy**	7
Culvert	N	**Appr. Alignment**	8

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	1
Pier Protection	1	**Appr. Guardrail**	1
Scour Critical	5	**Appr. Trans.**	1
Deck Pct. Unsnd.		**Appr. Term.**	1

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical			
Pinned Asbly.			
Underwater	Y	60	09/2004
Spec. Feat.			

* PAINT DATA *

Year Painted	**Pct.Unsound**
Total Painted Area	
Primer Type	
Finish Type	

* CAPACITY RATINGS *

Design Load	HS25
	MN
Operating Rating	HS 53.0
Inventory Rating	HS 32.0
Posting	Veh: Semi: Dbl:
Rtg Date	09-01-1994

* IMPROVEMENT DATA *

Prop. Work	
Work By	
Prop. Structure	
Length	**Width**
Appr. Rdwy. Work	
Bridge Cost	
Approach Cost	
Project Cost	
Data - Year/Method	

Mn/DOT STRUCTURE INVENTORY REPORT

Bridge ID: 4190 **TH 55 OVER MINN RIVER, RR, STREET** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No. (RS 2) - 2
District 05 **Maint. Area** 5A
County 19 DAKOTA (37)
City 2535 MENDOTA HEIGHTS
Township
Placecode 41696
Desc. Loc. 0.5 MI SE OF JCT TH 5
Sect. 28 **Tnsp.** 028N **Range** 23W
Lat. 44d 53m 05s **UTM-Y** 4970185.85
Long. 93d 10m 25s **UTM-X** 486280.70
Toll Bridge (Road) NO
Custodian STATE
Owner STATE
Inspector METRO DISTRICT
BMU Agreement No
Year Built 1926 **Yr Fed Rehab** 1992
Year Remod. 1992
Temp.
Skew 0 **Plan Avail.** CENTRAL

* STRUCTURE DATA *

Service On HWY;PED
Service Under HWY;RR;STREAM
MN Main Span 212 CONC CNT/ARCH
MN MSpn Det Def OPEN SPANDREL ARCH
MN Appr. Span 109 CONC/SLAB SPAN
MN ASpn Det Def
Culvert Type
Barrel Length
No. Main Spans 13 **No. Appr.Span** 6
Total Spans 19 **NBI Len. (?)** YES
Main Span Length 304.0 ft
Structure Length 4,113.4 ft
Abut. Mat'l. CONCRETE
Abut. Fnd. Type SPRD/ROCK
Pier Mat'l. CONCRETE
Pier Fnd. Type SPRD/ROCK
Deck Width 92.0 ft
Deck Material CIP CONC
Wear Surf. Type LO SLP CON
Wear Surf. Inst. Yr. 1992
Wr. Crs/Fill Depth 0.16 ft
Deck Membrane NONE
Deck Rebars EPOXY REBAR
Deck Rebars Inst. Yr. 1992
Structure Area 378,433 sq ft
Roadway Area 292,047 sq ft
Swk Width L/R 8.0 ft 4.0 ft
Curb Ht. L/R
Rail L/R/FHWA 22 22 YES
Ped. Fencing
Hist. Significance NATL REGISTER
Bird Nests (?) NO

* ROADWAY DATA *

Route System (Fed) STATE
Mn. Route System SPRK
Route Number
Roadway Name FT SNELLING PARK RD
Roadway Function MAINLINE
Roadway Type 2 WAY TRAF
Control Section
BDG. Reference Point
Date Opened to Traffic 07-01-1968
Detour Length 3 mi
Lanes 2 UNDER BRIDGE (2)
ADT 80 **HCADT**
ADT Year 1975
Functional Class URBAN LOCAL
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		26.0 ft	
Vrt. Clr. Ovr. Rd 1/Rd 2		17.8 ft	
Max Vert Clr Rd 1/ Rd 2		17.8 ft	
Horz U/Clr - Rd 1/Rd 2		327.8 ft	
Lat UndClr Left/Right			21.2 ft
RR UndClr Vert/Lat			40.0 ft
Appr. Surface Width		26.0 ft	
Median Width			

* 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
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 NOT APPL

Def. Status ADEQ **Suff. Rating** 85.7

* WATERWAY DATA *

Drng. Area
Wtrwy. Opening 99,999 sq ft
Navigation Control PERM REQD
Nav. Vert./Hrz Clr. 100.0 ft 220.0 ft
Nav. Vert. Lift Clr.
MN Scour Code N-STBL;LIM SCOUR
Scour Eval. Year 1993

* INSPECTION DATA *

Inspection Date 08-08-2005 (JTAM)
Inspection Frequency 24
Inspector METRO

Condition Codes		Appraisal Ratings	
Deck	7	**Struct. Eval.**	7
Superstruct.	7	**Deck Geometry**	7
Substruct.	7	**Underclearances**	9
Chan. & Prot.	7	**Waterway Adeq'cy**	7
Culvert	N	**Appr. Alignment**	8

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	1
Pier Protection	1	**Appr. Guardrail**	1
Scour Critical	5	**Appr. Trans.**	1
Deck Pct. Unsnd.		**Appr. Term.**	1

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical			
Pinned Asbly.			
Underwater	Y	60	09/2004
Spec. Feat.			

* PAINT DATA *

Year Painted **Pct.Unsound**
Total Painted Area
Primer Type
Finish Type

* CAPACITY RATINGS *

Design Load HS25
MN
Operating Rating HS 53.0
Inventory Rating HS 32.0
Posting Veh: Semi: Dbl:
Rtg Date 09-01-1994

* IMPROVEMENT DATA *

Prop. Work
Work By
Prop. Structure
Length **Width**
Appr. Rdwy. Work
Bridge Cost
Approach Cost
Project Cost
Data - Year/Method

Crew Number: 7647
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 4190 TH 55 OVER MINN RIVER, RR, STREET INSP. DATE: 08-08-2005

County: DAKOTA
City: MENDOTA HEIGHTS
Township:
Section: 28 Township: 028N Range: 23W
Span Type: CONC CNT / ARCH
NBI Deck: 7 Super: 7 Sub: 7 Chan: 7 Culv: n

Location: 0.5 MI SE OF JCT TH 5
Route: MNTH 55 Ref. Pt.: 198+00.617
Control Section: 1909 Maint. Area: 5A
Local Agency Bridge Nbr:

Length: 4,113.4 ft
Deck Width: 92.0 ft
Rdwy. Area / Pct. Unsnd: 292,046 sq ft
Paint Area / Pct. Unsnd:

Open, Posted, Closed: OPEN

Appraisal Ratings - Approach: 8 Waterway: 7 MN Scour Code: N-STBL;LIM SCOUR Def. Stat: ADEQ Suff. Rate: 85.7

Load Posting: NO SIGNS Traffic Signs: NO SIGNS Horiz. Cntl. Signs: NO SIGNS Vert. Cntl. Signs: NOT APPL

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
378	CONC SLAB-EPOXY&LSCO	0	2	08-08-2005	378,433 SF	0	378,433	0	0	0
				07-15-2004	378,433 SF	0	378,433	0	0	0
	Notes: Deck has a total length of 4,113 feet. Two lanes EB & WB each. [1994] Deck slab & low slump overlay replaced. [1995] 2 Minor spalls on EBL (1 SF).									
300	STRIP SEAL JOINT	0	2	08-08-2005	1,349 LF	1,349	0	0	N/A	N/A
				07-15-2004	1,349 LF	1,349	0	0	N/A	N/A
	Notes: [1994] Type H strip seals at piers and abutments.									
321	CONC APPROACH SLAB	0	2	08-08-2005	4 EA	4	0	0	0	N/A
				07-15-2004	4 EA	4	0	0	0	N/A
	Notes: [1994] Concrete appproach panels.									
331	CONCRETE RAILING	0	2	08-08-2005	12,343 LF	12,340	1	2	0	N/A
				07-15-2004	12,343 LF	12,340	1	2	0	N/A
	Notes: Rail code 22. [1994] 8233 LF Type J rail & 4110 LF solid median barrier. [2002] Median rail EBL 55 at east abutment has 3 SF of spall & 3 SF of delamination.									
333	RAILING - OTHER	0	2	08-08-2005	8,246 LF	7,746	500	0	N/A	N/A
				07-15-2004	8,246 LF	7,746	500	0	N/A	N/A
	Notes: Rail code 40. 8246 LF Special concrete rail, 6557 LF metal rail. [1994] Sidewalk rail reconstructed. Original steel rail was salvaged & reconditioned with new concrete posts. [1995] Bolted plates attached to reduce size of openings. [1997] Flaking & surface rust on metal rail. [2001] Rust stains at bolts & welds prevalent.									
144	CONCRETE ARCH	0	2	08-08-2005	7,843 LF	7,343	500	0	0	N/A
				07-15-2004	7,843 LF	7,343	500	0	0	N/A
	Notes: [1994] Arches repaired. [97/2002] Several areas of peeling special surface treatment.									
385	CONC SPANDREL COLUMN	0	2	08-08-2005	206 EA	206	0	0	0	N/A
				07-15-2004	206 EA	206	0	0	0	N/A
	Notes: [1994] Spandrel columns reconstructed.									
380	SECONDARY ELEMENTS	0	1	08-08-2005	1 EA	1	0	0	0	N/A
				07-15-2004	1 EA	1	0	0	0	N/A
	Notes: [1994] "X" Bracing at piers reconstructed, transverse struts between arches are original. "Corbels" at top of spandrel columns carry no structural load.									
311	EXPANSION BEARING	0	2	08-08-2005	14 EA	14	0	0	N/A	N/A
				07-15-2004	14 EA	14	0	0	N/A	N/A
	Notes: Seven moveable bearings on each abutment.									
205	CONCRETE COLUMN	0	2	08-08-2005	12 EA	0	12	0	0	N/A
				07-15-2004	12 EA	0	12	0	0	N/A
	Notes: [1994] West approach span columns reconstructed. [2004] Underwater inspection found typical random leaching vertical cracking on most columns from mud line to 6 FT above the water.									
215	CONCRETE ABUTMENT	0	2	08-08-2005	184 LF	184	0	0	0	N/A
				07-15-2004	184 LF	184	0	0	0	N/A

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 4190 TH 55 OVER MINN RIVER, RR, STREET INSP. DATE: 08-08-2005

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: < none >									
220	CONCRETE FOOTING	0	2	08-08-2005	990 EA	990	0	0	0	N/A
				07-15-2004	990 EA	990	0	0	0	N/A
	Notes: Original arch pier footings consist of 4 concrete caissons and a "H" shaped "footing cap". [1994] Deteriorated areas above & below waterline repaired.									
227	CONCRETE PILING	0	2	08-08-2005	48 EA	48	0	0	0	N/A
				07-15-2004	48 EA	48	0	0	0	N/A
	Notes: [1991] Underwater inspection. [1994] Deteriorated areas above & below waterline repaired.									
234	CONCRETE CAF	0	2	08-08-2005	12,580 LF	12,000	580	0	0	N/A
				07-15-2004	12,580 LF	12,000	580	0	0	N/A
	Notes: [1994] Spandrel caps reconstructed. [1997] Some spandrel caps (near center of arch) have diagonal shear cracks at the arch connections.									
358	CONC DECK CRACKING	0	2	08-08-2005	1 EA	0	1	0	0	N/A
				07-15-2004	1 EA	0	1	0	0	N/A
	Notes: [1995] Overlay has some random & map cracking. [2002] Overlay has two random cracks, EB & WB lanes, full length of the deck. A total of 16,452 LF of longitudinal cracks.									
359	CONC DECK UNDERSIDE	0	2	08-08-2005	1 EA	0	1	0	0	0
				07-15-2004	1 EA	0	1	0	0	0
	Notes: [1997] Underside of slab has longitudinal leaching cracks (typically 2 in each spandrel bay). Minor leaching below sidewalk.									
361	SCOUR	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A
	Notes: [1991] Underwater inspection by contract divers. [2004] Underwater Inspections by "Ayres Associates" found no evidence of scour.									
964	CRITICAL FINDING	0	2	08-08-2005	1 EA	1	0	N/A	N/A	N/A
				07-15-2004	1 EA	1	0	N/A	N/A	N/A
	Notes: Do not delete this critical finding smart flag.									
981	SIGNING	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A
	Notes: Overhead sign bridges at piers 9 & 14.									
982	GUARDRAIL	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A
	Notes: Plate beam guardrail EBL 55 at NW & SW corners, WBL 55 at NE corner. Crash attenuator (Quadguard Type I & II) EBL 55 west approach at EBL TH 5 exit ramp.									
984	DRAINAGE	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A
	Notes: 1/4 yard washout at SW corner end of east abutment wingwall. Deck drains at base north & south rail.									
985	SLOPES	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A
	Notes: Grouted riprap slopes at abutments.									
986	CURB & SIDEWALK	0	2	08-08-2005	1 EA	0	1	0	N/A	N/A
				07-15-2004	1 EA	0	1	0	N/A	N/A
	Notes: [1997] Ponding on sidewalk (numerous locations).									
988	MISCELLANEOUS	0	2	08-08-2005	1 EA	1	0	0	N/A	N/A
				07-15-2004	1 EA	1	0	0	N/A	N/A

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 4190 TH 55 OVER MINN RIVER, RR, STREET INSP. DATE: 08-08-2005

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: [1997] Temporary navigation lights still in place. [1997] Peregrine falcon nest on top of north arch (2nd span from east). Should not be disturbed during spring nesting season. Contact Mark Martell at U of M Raptor Center (651) 624-4745.

General Notes: Bridge #4190, Year 2005
Bridge constructed in 1926, extensively remodeled in 1992-94.

See 2004, snooper inspection report for additional information.

Inspectors: K Fuhrman & V Desens
2005 Inspector: Schmid

Inspector's Signature

Reviewer's Signature / Date

MENDOTA BR.

Novel Methods Used in Building Long Concrete Arch Bridge

Pier Foundation Cylinders Sunk from Overhead Suspension—Raising and Releasing Steel Arch Centers for 304-Ft. Spans of Fort Snelling-Mendota Bridge

By William H. DeButts
Resident Engineer, Koss Construction Co., Des Moines, Iowa

IN CONSTRUCTING the long concrete arch highway bridge across the valley of the Minnesota River between Fort Snelling and Mendota, Minn., several interesting features were developed. This bridge, now nearing completion, consists of thirteen open-spandrel two-rib arches 304 ft. c. to c., with a short slab approach, making a total length of 4,119 ft. Its roadway is 120 ft. above water. The foundations extend

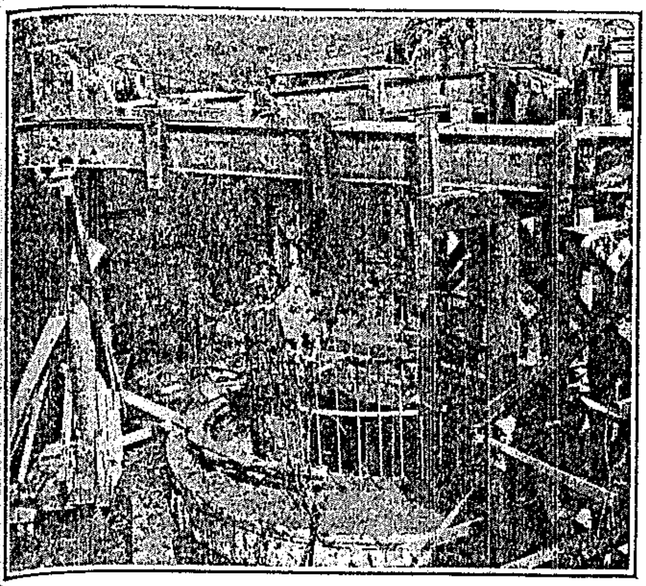

FIG. 1—CYLINDER FOR FORT SNELLING BRIDGE PIER FOUNDATION SUSPENDED WHILE SINKING

to solid rock at an average depth of about 80 ft. below ground level.

Foundation Piers—Each of the twelve main piers consists of four concrete cylinders connected by heavy reinforced-concrete walls above the ground. All of these cylinders were sunk by the open dredge method, additional sections of the concrete barrel being built as sinking progressed, so as to keep the top of the concrete above ground. The bottom section of each cylinder, 22 ft. in diameter and 11 ft. high, was reinforced by a structural steel frame, to the outer edge of which a steel cutting edge was attached. Above this bottom section or footing, the cylinders were of 14-ft. outside and 10-ft. inside diameter, having a 2-ft. wall reinforced with heavy vertical bars held in place by circular bar bands attached to them by U-bolts at every intersection.

No particular difficulty was encountered in sinking the cylinders, except that great care was necessary to keep them in exact position until the cutting edges were on bedrock. Then the cleaning of the rock surface was a problem, as the soil was such that the cylinders could not be unwatered without a "blow in" under the cutting edge, which would fill the bottom with sand and silt. The method adopted was to use a pipe jet, operated from the top, to wash the loose material from the edges to the center of the excavation, where it could be removed with a clamshell bucket. After this washing process, each cylinder was inspected by a diver before it was sealed, a seal coat 8 ft. thick being placed under water with bottom-dump buckets. After this concrete seal had set, the cylinder was pumped out and filled with concrete.

At one pier the footing cylinders were placed in about 14 ft. of water, and two other piers were located on swampy ground where the soil did not have sufficient bearing value to support the weight of the concrete as it was poured. Each of the twelve cylinders of these three piers was supported by means of three heavy blocks and falls hung from a triangular frame of

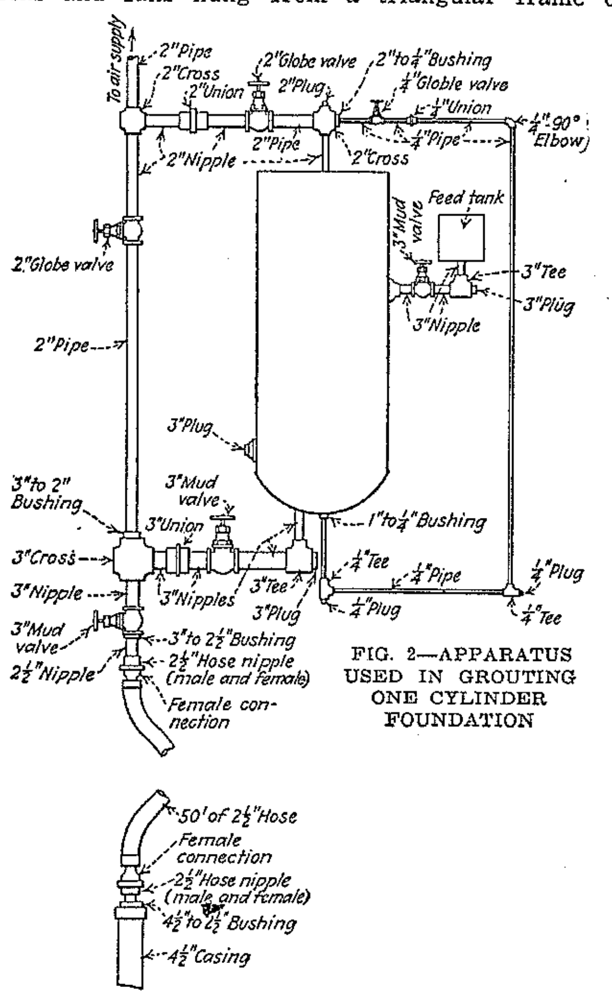

FIG. 2—APPARATUS USED IN GROUTING ONE CYLINDER FOUNDATION

I-beams which rested on pile bents, as shown in Fig. 1. Sufficient tackle was provided to support all four cylinders of one pier at one time. Heavy cable slings were attached to the steel frame of the cutting shoe and the lower blocks were fastened to these slings with a specially designed releasing shackle, which could be released under water when the bearing value of the soil became sufficient to support the weight. This method of handling in soft ground proved very satisfactory and the supporting cables had the added advantage of helping materially in controlling the position of the cylinder during sinking.

With one exception the bedrock under the footings was level. Under this one footing a fault in the bedrock caused a slope of about 6 ft. in the rock surface in the 22-ft. diameter of the cylinder shoe, although the rock was level under the other three cylinders of the pier. When the cutting edge rested on the highest part of

After the two halves of the steel arch have been lifted to the required height, the center pins are placed in position and the winches are slacked off until the load is carried on the pins. A complete set of centers for one arch weighs about 400 tons. Each half requires four 2½-in. galvanized bridge cables for backstays. The tackle on each of the four forelines for each half of centers is reaved up with nine parts of ⅞-in. cable. Each of the wooden bents has four 60-ft. posts 16x16 in.

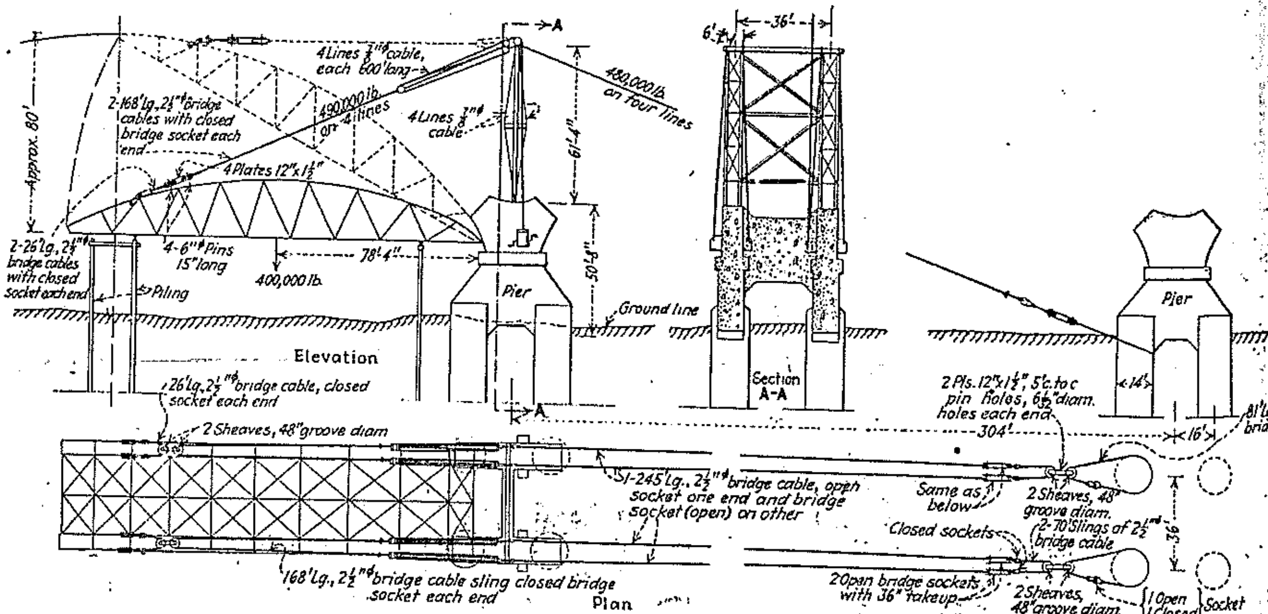

FIG. 3—WEDGES FOR RELEASING ARCH CENTERS

the rock, the excavation was stopped, while the clean coarse sand and gravel overlying the rock was grouted with a mixture of cement and water forced by air pressure through pipes driven to the rock. The pipes were gradually withdrawn as the grouting proceeded. This apparatus is shown in Fig. 2. After allowing time for this cement to set, test holes showed a good impregnation of the cement and proved that the grouting had been successful.

Handling Arch Centers—The great height of the concrete arches and the extremely small bearing value of the soil combined to make it more economical to use steel instead of wood for arch centers. These steel centers, Fig. 5, have also proved their advantages in speed and economy. They are three-hinged arches supported at the ends on cast-steel shoes set on the concrete pier caps.

An unusual method employed for handling the steel centers is illustrated in Figs. 4 and 5. Each half-span of centering is erected in a horizontal position at the level of the spring line of the concrete arch, with the pier end resting on the cast steel shoe mentioned above. Wooden bents 60 ft. high are erected over the pier skewbacks. Back stays or guys run from the tops of these bents to an anchorage around the cylinders of the next pier. The fore lines are attached to the steel centers near the tip and lead through a 9-part tackle to the top of the bent. The free end of the line is carried down to a special winch mounted on the side of the pier. Eight of these winches, each operated by an electric motor, are required to lift a single span of centers. Both the backstay and foreline cables are hitched up in pairs around equalizer sheaves, so as to distribute and equalize the loads on the different lines.

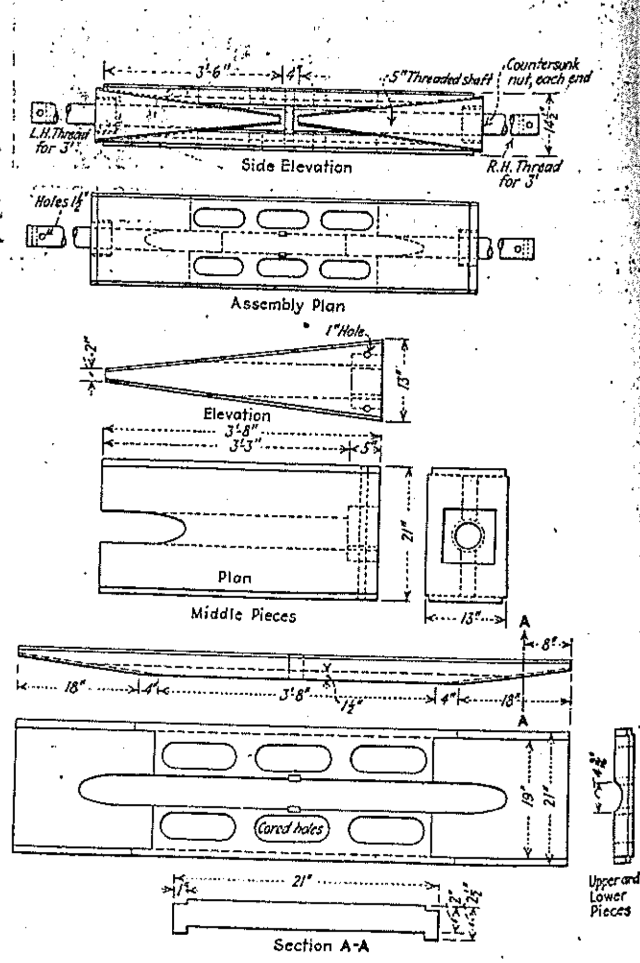

FIG. 4—LAYOUT OF TACKLE FOR HANDLING ARCH CENTERS

capped with another 16x16-in. timber. These bents are heavily swaybraced, which stiffens the column in one direction, while truss cables support them in the opposite direction.

The bottoms of the wooden columns were cut semi circular and shod with steel plates, which rest in cast-iron shoes of the same shape, anchored to the top of the concrete pier. Besides decreasing the bending moment in the posts under unequal loads, the semi-circular ends facilitate the connection of the backstay cables, because the bent is leaned back to give enough slack to make the backstay connection, after which the foreline is tightened with the winches to bring the bent back into an upright position.

With the centers in place, forms are placed for the arch rib, the reinforcing is placed and the concrete poured. The centers are removed in from 30 to 45 days, depending on the weather. Double-end steel wedges, Fig. 3, are used to release the weight of the concrete from the centers. Cast-iron shoes which are pin-connected to the pier ends of the arch centers rest on the double-end steel wedges, supported on cast-steel shoes on the pier caps, which were heavily reinforced for this purpose. Each of the wedges consists of a cast-steel cap plate and a base plate between which are placed two steel wedges with the points facing each other.

Through the center of the wedges there is a 5½-in. bar, threaded on both ends, one end with right-hand and the other end with left-hand threads. This threaded rod has holes in each end for capstan bars by means of which it can be turned, so that the wedges are forced apart and the cap plate is lowered. Each side of the tapered wedges has a slope of 1 on 8, so that a horizontal movement of 4 in. will lower the wedge 1 in. As a total of 16 in. of horizontal travel is provided, it is possible to lower the wedge 4 in., which is enough to take care of the deflection in the steel centers and provide sufficient clearance for the release of the center pin.

Eight heavy hand winches with special brakes are mounted over the center of the concrete ribs for lowering the centers. The ⅞-in. cables from these winches lead through a four-part tackle, the upper blocks of which are attached in pairs to either end of a 2½-in. equalizer cable, supported on a saddle over the center of the rib. The lower blocks are attached to the bottom chord of the arch centers, near the tip. After the wedges have been lowered, the pressure is released from the center pin by lifting the centers with the above described tackle and the pin is removed. Then the centers are lowered into a horizontal position, the speed of lowering being regulated by the brakes on the winches.

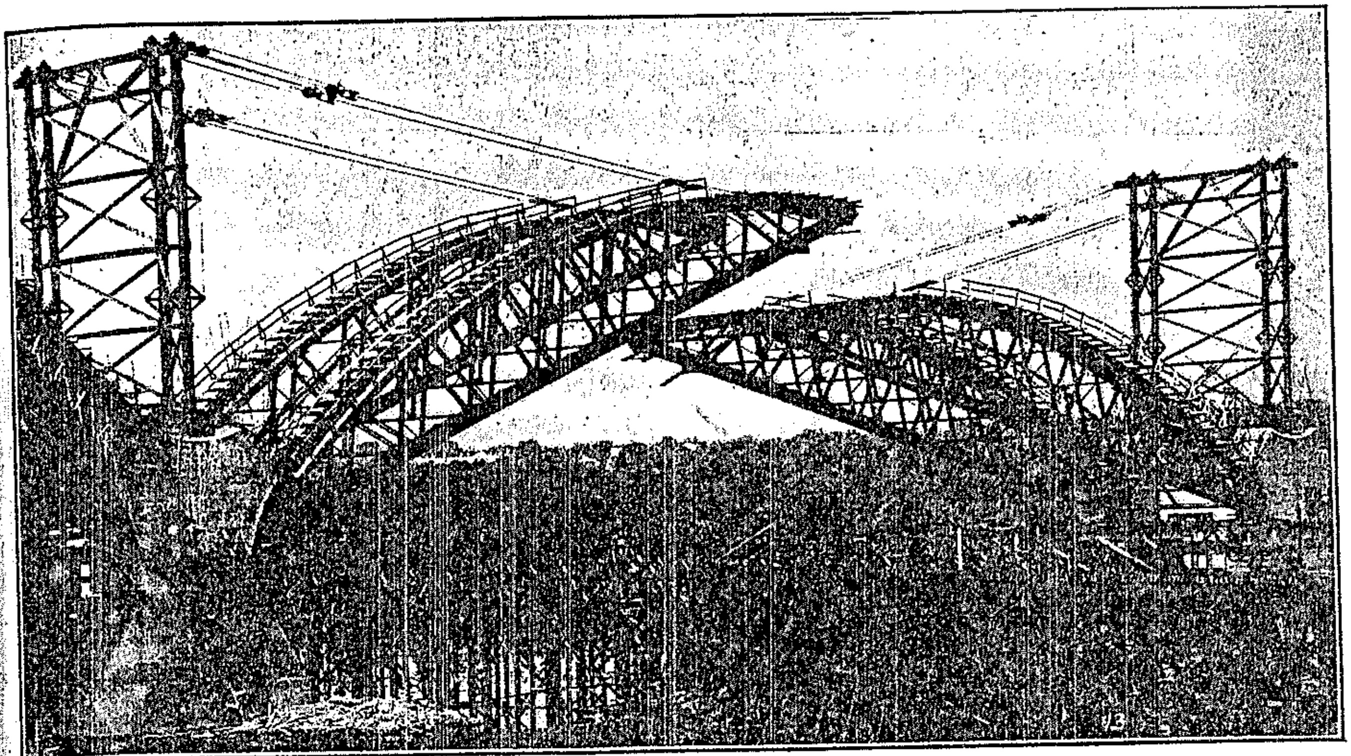

FIG. 5—RAISING STEEL ARCH CENTERS

With the centers in a horizontal position the wind bracing is removed and they are skidded out transversely, a quarter at a time, on greased rails onto two standard-gage steel trucks of 80 tons capacity. These trucks stand on the crane track, which parallels the center line of the bridge at a distance of 39 ft. and at approximately the elevation of the springing line of the concrete arches. The centers are then pulled forward along the crane track to the third span ahead, where they are again skidded transversely to position in the new span. The wind bracing is then replaced and the centers are raised again as has been here described.

This bridge was designed by Walter H. Wheeler and the C. A. P. Turner Co., associated, of Minneapolis, and is being built under their supervision by the Koss Construction Co., Des Moines, Iowa. All of the above special equipment, with the exception of the arch centers, was designed by the writer, as resident engineer for the contractor.

Long Concrete-Arch Road Bridge Over Minnesota River

Thirteen Two-Rib Spans Carry Highway 120 Ft. Above Water—Steel Centers—Caissons Sunk 55 to 90 Ft. by Dredging—Grouting Foundation — Design and Construction Features

BY WALTER H. WHEELER
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THE Fort Snelling-Mendota bridge and the new highways which connect it with important centers and with the main trunk highways of Minnesota constitute a major highway development and one of the most important links in a system of paved highways having Minneapolis and St. Paul as its center. This bridge shortens the distance between Minneapolis and points south and east of Minneapolis by about five miles and correspondingly shortens the distance for through traffic on some of the heavily traveled trunk highways. By avoiding congested districts it reduces running time about half an hour.

This bridge was financed by Hennepin County. Before engaging to undertake the engineering of this project for the county, the writer stipulated that the county board should agree to keep politics and individual interests out of it and allow the engineer a free hand to secure the desired results at the least cost and with the maximum efficiency. It is to the credit of the board that it quickly agreed to that program.

Fig. 1 is a general view of the completed bridge and Fig. 2 shows the completed ribs of one span on the steel centers. Fig. 3 shows further details of the completed structure.

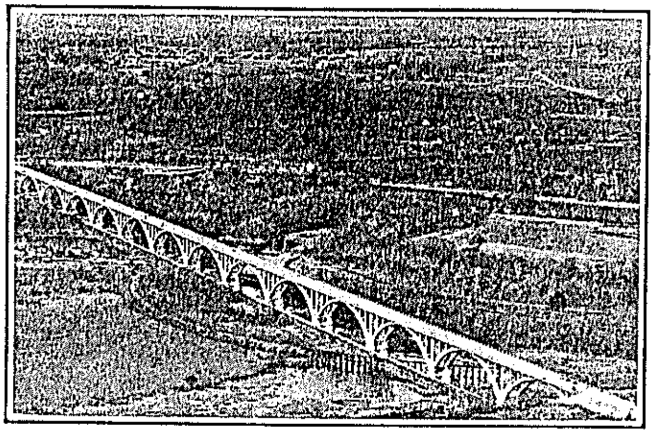

FIG. 1—FORT SNELLING-MENDOTA BRIDGE

Geological and Topographical Conditions—According to the geologists, the Minnesota River meanders through a gorge cut by a great glacial river, known as River Warren, of which the Mississippi River was a branch. The Falls of St. Anthony, at Minneapolis, were cut back along this river to the confluence of the Warren and the Mississippi, thence up the Mississippi to their present location and up River Warren about 2½ miles, leaving a gorge some 200 ft. deep. A later ice flow ground off the layer of shale which overlay the surrounding country rock and filled the gorge with glacial mud to a depth of 70 to 80 ft. The old gorge in the vicinity of Fort Snelling is from 4,000 to 5,000 ft. wide, while the main channel of the Minnesota River is 300 to 400 ft. wide and 10 to 40 ft. deep. On both sides of the channel are lakes and marshes. At times of extreme high water the low lands are covered with 4 to 6 ft. of water for practically the full width of the old gorge.

Test drilling showed that the foundation conditions in the gorge are substantially the same at all points below the old falls, namely, 70 to 80 ft. of mud over sandstone or limestone bedrock, with a few feet of sand and gravel on top of the bedrock in some places. At the mouth of the Minnesota this condition changes and more gravel and boulders are found. The banks of the old river rise abruptly on each side of the gorge. There is a capping of about 20 ft. of Trenton limestone on top of 160 to 170 ft. of soft St. Peter sandstone; below is hard Shakopee limestone. The sandstone becomes quite hard near the contact with the limestone and some of the sandstone remains in places overlying the limestone at the bottom of the old gorge. In excavating one caisson a section of a vertebra was brought up from 60 ft. down in the mud which was identified as that of a pre-glacial buffalo.

As the Minnesota River is considered by the War Department to be a navigable stream, the same clearance for navigation is required as on the Mississippi River. The Chicago, St. Paul, Minneapolis & Omaha line of the Chicago & Northwestern Ry. is at the foot of the bluff on the Mendota side of the river. The Chicago, Milwaukee & St. Paul R.R. crosses the Minnesota on a swing bridge and has another line on top of the bluff on the Mendota side. The Fort Snelling military reservation is on the Minneapolis side, and the War Department would only permit crossing the reservation with a road at certain points, complicating the bridge location problem.

Bridge Location and Type—Four locations were made for a low-level bridge with draw span and long grades on fills and trestles up the bluff on either side of the river, and two locations for a high-level bridge. It was desired to eliminate all grade crossings and also the draw span if possible. Due to the foundation conditions and other limiting factors it was found that while a high-level bridge would be somewhat more expensive in first cost, the lower upkeep and its greater value to the users of the highway by eliminating grades and curves and shortening distances made it the best investment for the county.

On the ngineer's recommendation, the county first adopted the high-level bridge on location No. 1, because the length of bridge was about 100 ft. less than on No. 2 and the bridge would cost $50,000 to $100,000 less. Serious complications, which seemed insurmountable, developed in securing right-of-way, and on the recommendation of the engineer the county board then adopted location No. 2, some 400 ft. upstream.

Four types of design were considered: (1) Reinforced-concrete rib arches on concrete piers with caisson foundations; (2) steel arches with concrete piers and caisson foundations; (3) steel deck trusses on concrete piers and caisson foundations; (4) steel deck trusses on steel towers with pile foundations. The estimated cost of the various designs was in the order

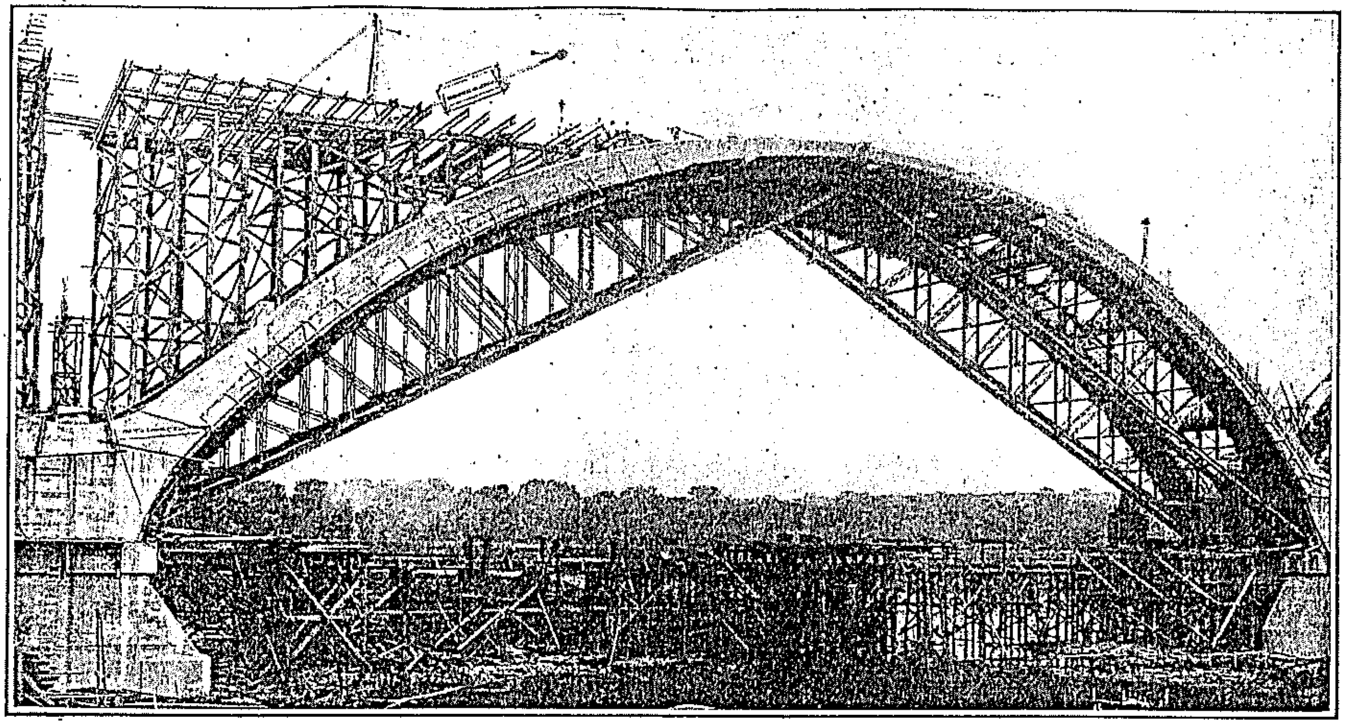

FIG. 2—COMPLETED ARCH RIBS ON STEEL CENTERS

given, type 1 being the most expensive. After going into the matter very fully the engineer recommended type 3, but because of the strong preference of the board for a concrete bridge he agreed to prepare working plans and specifications and to receive bids for types 1 and 3.

Bids were received in February, 1924. The low bid on the reinforced-concrete arch bridge, complete, was $1,870,000, with 30 months for construction. The lowest formal bid on the steel bridge complete with

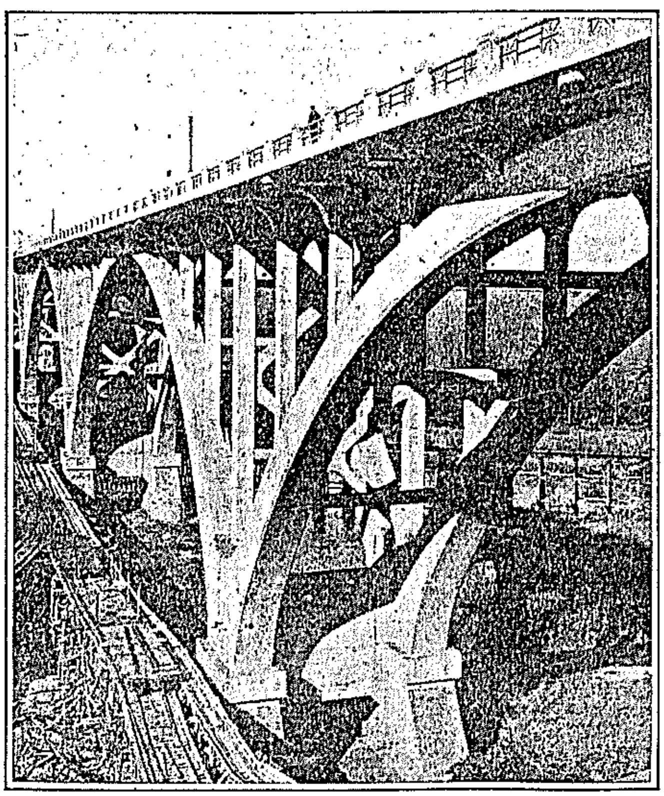

FIG. 3—PORTION OF FINISHED BRIDGE
Sidewalks cantilevered over arch ribs. Metal parapet between concrete posts. Construction trestle at left.

buckle plate floor, was $1,766,000; and 22 months time. An alternate bid on the steel design, with I-beam and concrete slab floor, was $1,713,807, with 28 months time, but this bid was informal and could not be considered.

The engineer had estimated difference in cost between the steel bridge and reinforced-concrete bridge at approximately $250,000, but the only two bids for the steel bridge complete were disappointing, while the concrete bridge was preferred by the county board. After carefully weighing the various phases of the problem, the low bid on the concrete bridge was accepted. The contract was executed in February, 1924, and the date of completion was fixed at Sept. 26, 1926.

Description of Structure—The bridge is 4,066 ft. long between abutments, or 4,119 ft. including the end abutments. It has a roadway 45 ft. wide between steel-nosed curbs 11 in. high, with a 6-ft. sidewalk on each side, the width overall being 60 ft. 8 in. The roadway is paved for 41 ft. with 2 in. of asphaltic concrete, while concrete gutters 2 ft. wide, have 4-in. drains spaced 30 ft. 6 in. c. to c. Provision is made in the floor for a future double-track street car line. The roadway is designed to carry 25-ton tractors and the sidewalk for 100-lb. live-load.

The superstructure consists of twelve two-rib arch spans 304 ft. c. to c. of piers (283 ft. 4 in. clear), one three-fourths arch span at the Mendota end and five trestle spans at the Fort Snelling end. The floor is of flat-slab construction reinforced four ways, with depressed panels and bracketed column capitals. The columns are supported on the arch ribs. Expansion joints are provided in the floor of the bridge at each end abutment and over all piers, except piers 5 and 17, and are covered by double steel angles. Over the piers at expansion joints are double columns and double sets of sway bracing. Over the end piers are single columns with single sway bracing. Between arch ribs are struts located at points of column support.

In section, the arch ribs are square at the crown, tapered to the haunch and rectangular at the skewback. They are reinforced with spirals and longitudinal bars in the same manner as a spirally hooped column, with two additional bars in each corner tied with tie bars at close intervals to the core of the rib. These corner bars supply the additional tension steel required during construction, and afterwards serve as corner reinforcing. The columns which support the floor are reinforced with verticals and spiral hooping, except over the piers. Pier columns which are rectangular instead of square are reinforced with verticals and ties. The corners of arch ribs and columns are chamfered. Octagonal struts between the piers are reinforced with longitudinal bars and spiral hooping.

TABLE I—RECORD OF CENTERING: FORT SNELLING-MENDOTA BRIDGE

Span	Date Raised	Date Struck	Span	Date Raised	Date Struck
16–17	5/21/25	9/30/25	10–11	4/21/26	6/29/26
15–16	6/25/25	11/19/25	9–10	5/19/26	7/22/26
14–15	9/ 8/25	1/ 6/26	8– 9	6/14/26	8/12/26
13–14	10/28/25	4/12/26	7– 9	7/ 8/26	9/ 1/26
12–13	12/ 7/25	5/10/26	6– 7	7/29/26	9/27/26
11–12	2/ 1/26	6/ 5/26	5– 6	8/19/26	10/11/26

Abutments are of the hollow box type, and the end piers of the two end arches are built into the rock in the sides of the gorge. Twelve of the piers of the main arches are each supported on four cylindrical caissons sunk to bedrock at 55 ft. to 90 ft. and averaging about 70 ft. below the surface of ground or water. The shoe of each caisson, of reinforced concrete built into a structural steel frame, is 22 ft. in diameter and 11 ft. high, with a steel cutting edge. At the top of the shoe there is a 4-ft. offset made in two stages to the barrel of the caisson cylinder, which is 14 ft. in outside diameter. The shells of the caissons were built up in sections 5 ft. and 10 ft. high and 2 ft. thick, leaving a 10-ft. shaft through which the dredging was done. After sinking, the caissons were sealed with rich concrete and filled with 1:3:5 concrete in which rubble stone was embedded.

TABLE II—ARCH DEFLECTIONS: FORT SNELLING-MENDOTA BRIDGE

Span	Deflection At Crown: Center Line, Ft.	Deflection At Crown: Edge of Sidewalk, Ft.	Deflection At ¼-Point: Center Line, Ft.	Deflection At ¼-Point: Edge of Sidewalk, Ft.	Date
	A. Deflections when centers were struck				
17–18	—.040	......	......	......	8/ 3/25
16–17	—.031	......	+.005	......	9/30/25
15–16	—.021	......	+.006	......	11/19/25
14–15	—.01	......	+.005	......	1/ 6/26
13–14	—.034	......	.00	......	4/12/26
12–13	—.008	......	—.003	......	5/10/26
11–12	—.008	......	.00	......	6/ 5/26
10–11	—.015	—.017	—.003	—.003	6/29/26
9–10	—.013	—.012	—.002	—.002	7/22/26
8/ 9	—.011	—.013	—.006	—.006	8/12/26
7– 8	—.012	—.012	.00	—.003	9/ 1/26
6– 7	—.011	—.011	.00	.00	9/27/26
5– 6	—.009	—.009	.00	.00	10/11/26
	B. Deflections During Lowering of Centers				
17–18	Centers of this span not lowered from deck				......
16–17	—.01	......	.00	......	10/ 5/25
15–16	.01	......	.00	......	11/20/25
14-15	—.01	......	+.001	......	1/14/26
13–14	—.005	......	.00	......	4/14/26
12–13	—.008	......	+.002	......	5/11/26
11–12	—.007	......	.00	......	6/ 7/26
10–11	—.011	—.011	—.002	—.002	6/30/26
9–10	—.002	—.007	.00	.00	7/23/26
8– 9	—.005	—.007	.00	.00	8/13/26
7– 8	—.007	—.007	.00	.00	9/ 4/26
6– 7	—.008	—.008	+.002	+.002	9/29/26
5– 6	—.008	—.007	+.002	+001	10/13/26

All piers except the end piers are designed to permit construction of the bridge with three sets of centers and to take the unbalanced loads of construction with that system of centering. The end piers are designed as abutment piers.

Hand Rail and Lamp Posts—The parapet or hand rail, Fig. 3, consists of a reinforced-concrete curb 10 in. wide and 8 in. high between concrete posts 51 in. high, 36 in. wide and 14 in. thick, paneled on both sides. The end posts and posts supporting lamp standards are 4½ ft. wide. Between posts, the rail is 3 ft. 3 in. high and consists of built-up steel panels with top member of 4-in. steel pipe having the ends let into cast-iron flanges in the concrete posts, but left free for expansion and contraction movements. Cast steel panels bolted to the pipe and to the curb are connected by steel angles.

Provision is made in posts at suitable intervals to support future poles for a street railway. Cast-iron lamp posts have 1,000-cp. lamps in ripple-glass globes with asymmetric domes. Lighting is controlled by time clocks and also by a key switch at each light. Electric conduit to supply the lights is carried in the sidewalk slab under the hand rails. Two 4-in. fiber conduits for telephone wires, with one 3-cell and one 6-cell tile conduit are buried in one sidewalk, with manholes at intervals. One 6-cell tile conduit is buried in the opposite sidewalk, with provision for installing manholes when required.

Materials and Construction—The steel centers for the arches were designed in accordance with recommendations of the engineer, who checked the design and details. The concrete mixing plant was also designed in accordance with his requirements and subject to his approval. The engineer furnished center line, grade and bench marks at each end of the bridge and the contractor laid out his work from these points.

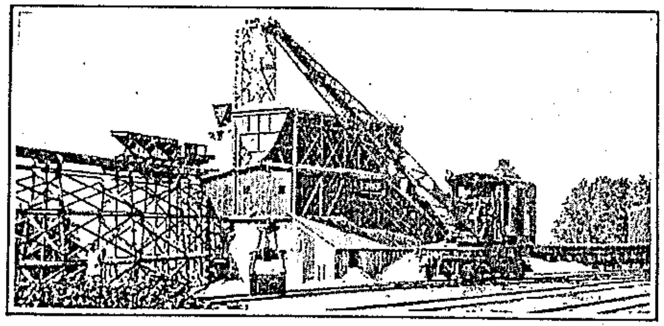

FIG. 4—CONCRETING PLANT FOR FORT SNELLING-MENDOTA BRIDGE

Cement shed at right. Material bins over mixer house. Elevator bucket delivers concrete to side-discharge hopper cars.

A minimum mix of 1:2:4, using gravel or crushed rock, was specified, except for the caisson filling and the hand railing. Control of water ratio and a minimum strength of 2,400 lb. per sq.in. on concrete test cylinders at the age of 28 days were also specified. The sizing and quality of aggregates were particularly specified, including hardness, toughness and water absorption for the coarse aggregate, thus eliminating materials known to disintegrate rapidly by frost action and weathering. The specifications also provided that sand and gravel must be washed and that if crushed rock was used it must be free from dust. Gravel aggregate was used throughout, with the exception of a small amount of caisson concrete made with crushed rock. Structural and intermediate grades of steel were used for all reinforcing, including spirals. All vertical surfaces of the concrete above ground level were ground dry with carborundum stones by electrically driven machines, except that the hand-rail posts were rubbed with carborundum blocks and water.

The concreting plant, Fig. 4, was set up at the Mendota end of the bridge and a railroad yard built from a spur of the C., M. & St. P. R.R. at the top of the bluff. At the foot of the bluff, the C., St. P., M. & O. R.R. had a passing track which the contractor arranged to use for unloading and loading equipment and materials and to which the working trestle was connected by a switch which permitted the locomotive cranes to operate on this passing track when necessary. A cement shed with capacity for several thousand barrels was served by a belt conveyor which delivered the cement sacks to the charging floor. Four steel storage bins for fine and coarse aggregates, with batchers, were above the mixer hoppers.

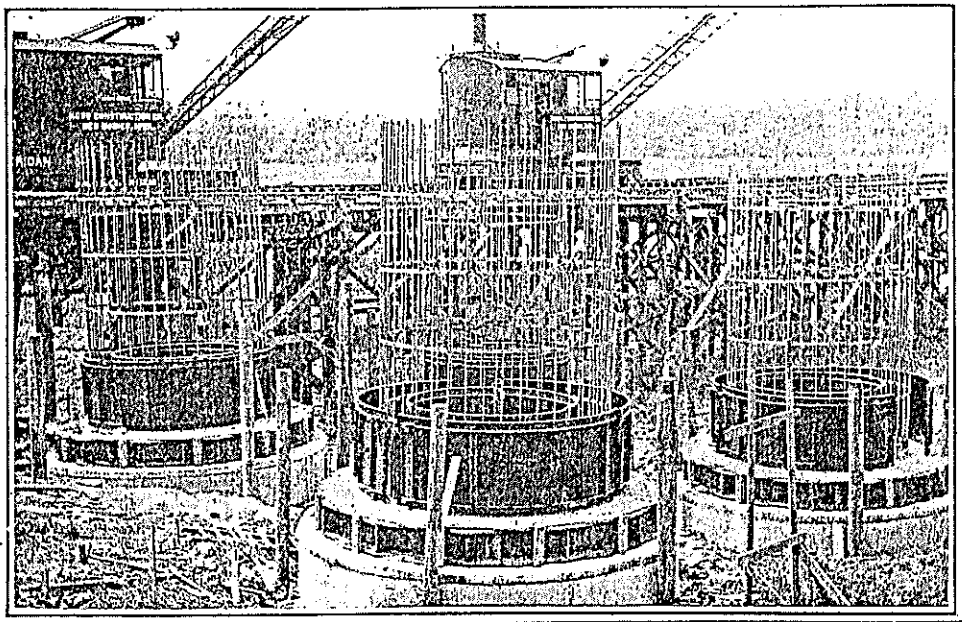

FIG. 5—(ABOVE) SINKING PIER CAISSONS
Locomotive cranes on construction trestle handled grab buckets, placed steel forms and poured concrete.

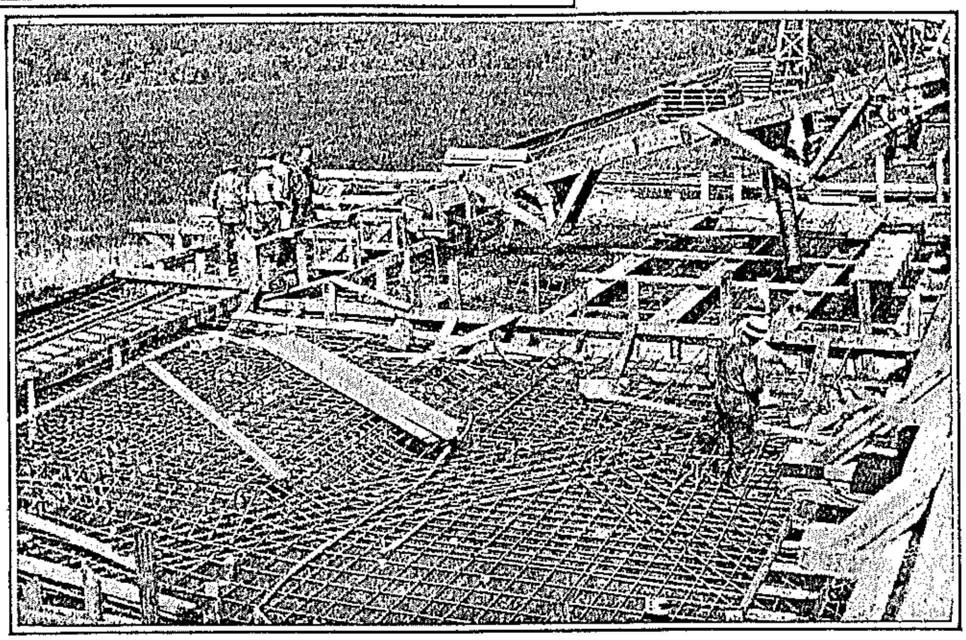

FIG. 6—(BELOW) CONCRETING THE FLOOR SLAB
Wood chute with drop pipes delivers concrete in place. Note heavy reinforcement.

Two ¾-yd. mixers driven by electric motors dumped into metal-lined wood spouts arranged to discharge into a hoisting bucket to deliver the concrete to a steel hopper. This hopper discharged to side-dump cars on an elevated track and also into a steel chute which delivered the concrete to a large steel hopper set over an industrial track below to discharge into bottom-dump cars. This track was laid out on the working trestle beside the standard-gage track on which the cranes operated. All concrete, except that used in columns and floor slab, was hauled out on the lower track in trains of four to six cars by gasoline locomotives and was deposited by locomotive cranes. On the upper track, the concrete was hauled in trains of three and four cars by gasoline locomotives and dumped into wooden chutes which delivered the concrete in place.

Concreting—During construction of the arch ribs, the order of pouring concrete on each pier was checked by the contractor's engineer and by the bridge engineer. The same order of pouring the sections of each arch rib was maintained throughout and at least 48 hours elapsed after all other concrete was poured before the key sections were poured. The arch rings were poured in nine sections, including key sections. The floor was poured in alternate sections. Fig. 6 shows the floor reinforcement and concreting chute with drop pipes.

Sand inundators were installed in 1925, although good and uniform concrete had been secured previously by careful handling. The total amount of water in the concrete per sack of cement ranged from 6½ to 6¾ gal. This was reduced to 6¼ gal. after the inundators were installed, without decreasing the workability of the mix, while a more uniform consistency was obtained. The strength of concrete, as determined by 28-day test cylinders 6x12 in. had an extreme range of 2,413 to 2,825 lb. per sq.in. for all cylinders taken before installing the inundators. Those taken with the inundators in use showed higher strength, ranging from 2,672 to 3,521 lb.

Work on the piers progressed continuously through the winter of 1924-25, the water and aggregates being heated so that the concrete reached the forms at 100 to 110 deg. F. The fresh concrete was enclosed in canvas and kept warm by salamanders under this covering. In the winter of 1925-26, work on the superstructure was stopped from Dec. 22 to March 3, but before closing down some of the work was done at temperatures ranging down to 10 deg. below zero, even lower temperatures being reached while the concrete was still green. Here the arch ribs were enclosed in canvas and the floor in board sheds and canvas, and the concrete was kept warm for a week after pouring. No difficulty was experienced in keeping the concrete warm and no concrete was frozen. These precautions for cold weather work were provided for in the specifications.

Construction was begun at the Mendota end, but the abutment and trestle at the Fort Snelling end were constructed separately during the progress of the work. The working trestle 4,000 ft. long was of standard railroad type, 20 ft. above low-water level, built along one side of the bridge. Piles 70 ft. long were required. For the bents opposite the piers, where the cranes worked while sinking the caissons, the piles were driven flush and capped at the ground or water line to carry

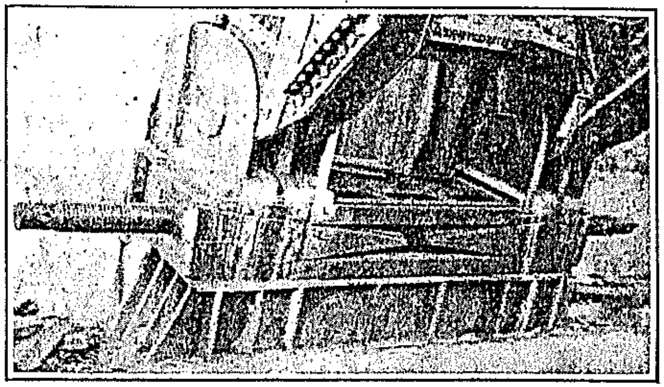

FIG. 7—WEDGES FOR LOWERING ARCH CENTERS

trestle bents. Work was carried on at several piers at one time. Four locomotive cranes were employed, one unloading sand and gravel and other material in the yard at the top of the bluff to keep the aggregate bins above the mixing plant filled, and the other three cranes on the foundation work; when that was completed, one crane was released while the others finished the work.

Caisson Work—Preliminary soundings showed the bedrock to be nearly level across the full width of the gorge, sloping slightly at the two caisson piers nearest each end. At pier 12, one caisson landed in a pothole in the rock with the edge of the caisson toward the Fort Snelling end resting on the sloping side of the hole. Prospecting with a drill showed that the pothole was filled with sand and gravel and was only 6 or 7 ft. below the bottom of the caisson. To use compressed air and cut out a seat in the rock for the caisson would have been expensive. The writer decided to try grouting the sand and gravel in the pothole, and prepared a sketch of the grouting machine from which it was built by the contractor. This machine was tested first in similar material to see what penetration could be expected (illustrated in *Engineering News-Record* Oct. 14, 1926, p. 621).

Five grout pipes were sunk to bedrock and grouting begun early in the morning was carried on until the work was complete, the pipes being pulled gradually as grouting progressed. This work was done under 90 ft. of water. After the grout had set, drill holes showed that the grouting had succeeded. The total cost of the operation was less than $3,000, as compared with an estimated cost of $30,000 to $35,000 with air locks.

Caissons were required to be centered correctly and plumb within 9 in. and these requirements were closely adhered to. One caisson slipped out of plumb about 3 ft. when it had nearly reached bedrock, due to too rapid digging on the inside, but was forced into place by using hydraulic jacks against the thick ice and jetting on the opposite side. The pressure applied was about 300 tons and the caisson was straightened up in a few days. It was possible to unwater a number of the caissons after they reached bedrock and clean them by hand, after which they were allowed to fill with water and were sealed under water. The majority of the caissons could not be unwatered. These were cleaned by jetting and inspected by a diver who also assisted in the final cleaning up.

Steel Arch Centers—Handling the steel centers, Fig. 2, was one of the problems of the work which the contractor solved very well. As described in *Engineering News-Record*, Oct. 14, 1926, p. 621, the centers were assembled in a horizontal position in four sections on skids; then the wind bracing was put in and the centers were raised in two halves, each half weighing about 205 tons. The forms for the center three panels of the floor in each span were supported on I-beams which in turn were carried on the steel centers. The rest of the floor forms were supported on bents from the arch ribs and steel I-beams across these bents.

The time of striking the steel centers was determined by the age and hardness of the concrete in the three middle spans of the floor, since the forms for this part of the floor were necessarily struck with the steel centers. The dates on which centers were raised and struck for each span are given in Table I. This omits the first or three-fourths arch span, as its centers had to be erected on falsework and taken apart for removing. As centers were removed they were shifted ahead three spans and raised again, until the last span was reached. Fig. 7 shows the steel wedges and shoes, with operating screws, for striking the centers.

As the arch centers were struck and lowered, readings were taken of the deflections in the arch ribs and floor, as given in Table II. A minus reading is a deflection downward and a plus reading is a deflection upward. In lowering the centers, the load of the free ends of the centers and of the lowering machinery, or a total of about 210 tons, was carried on the floor of the bridge at the middle of the arch span.

When the centers were struck, the floor had not been poured on the whole of the span. In some cases two panels were not poured on each half of the arch span. This condition produced tension on the top of the arch rib at the quarter point and a slight rise at the quarter points resulted when centers were struck. On other spans only one floor panel on each half of the arch span remained to be poured but the resulting tension did not produce a rise at the arch rib quarter point.

General Information—Remarkably fast progress was made on the construction of the superstructure during the spring and summer of 1926. Centers for an entire span on the last four or five spans of the bridge were struck, lowered, moved ahead 900 ft. and raised again in $5\frac{1}{2}$ to 6 days. Only about $3\frac{1}{2}$ weeks was required to strike, lower, move and raise centers, build forms and pour concrete for each of the last six spans, including arch ribs and floor complete for a 304-ft. span. During the summer of 1926 the concrete mix for 90 ft. of floor at the crown, which was supported on forms from arch centers, was changed by the contractor to $1:1\frac{3}{4}:3\frac{1}{2}$ in order to shorten the time the forms were left in place, with the result that test cylinders showed that forms could be removed in 12 to 13 instead of 16 to 17 days.

Fire and tornado insurance was carried by the county on completed work and on materials which had been delivered to the site and paid for in monthly estimates, and the contractor was required to carry insurance on his equipment and forms.

The approach roads were completed in 1926, so that when the bridge was ready to open to traffic on Nov. 8, 1926, the entire project was complete. The bridge was dedicated to the 151st Field Artillery, U. S. A. In all, twelve contracts were let on the entire project, all to the low bidder on first advertisement.

Engineers and Contractors—Walter H. Wheeler and the C. A. P. Turner Co., Associated, were designers and engineers of the bridge. M. G. Hyde was chief office engineer. F. A. Camp was resident engineer until January, 1926, when he asked to be relieved because of advancing years. W. C. Jorgenson was resident engineer for the rest of the job, and E. M. Beal was inspector. The Koss Construction Co., Des Moines, Iowa, had the general contract, with Frank Kratoska as general superintendent and William De Butts as engineer.

Power Requirements of Industrial Plants and Steel Mills

Use of Steam or Electric Power, Produced in Plant or Purchased, Depends Upon Economic Factors and Individual Plant Processes

ABSTRACTS of two of the papers read at the recent Midwest Power Conference in Chicago, relative to power requirements of industrial plants and steel mills follow:

Industrial Power Plants (By Samuel G. Neiler, consulting engineer, Chicago)—In relation to the development of industrial power plants it may be said that engineers thoroughly versed in individual branches such as construction, furnace design, heating or refrigeration may not be capable of visualizing and correlating all the items which enter into the engineering field of industrial work. It is only within the past few years that concentrated effort has been made to analyze plant conditions with the idea of increasing economy in production not only as to the power plant but, which is most important, in the manufacturing departments of the industry. Many advances have been made in the economical production of power, utilization of byproducts, higher machine speeds and improvements in handling and factory routing of manufactured products. A summary of some power-plant functions is:

Electricity: For light and power, ovens, laboratory heating units, welding.

Steam: For heating buildings or water; for dry kilns and process work.

Compressed Air: For drills and other tools or machines; hoists; oil or pulverized-coal furnaces; foundry molding machines and special equipment.

Water: For domestic and fire purposes and for process work; refrigerated water for drinking; high-pressure water for riveters and other machines.

Miscellaneous: Dust-collecting systems are required for foundries, wood-working mills and other industries. In foundries there is also sand handling and conditioning apparatus. In manufacturing plants, transportation methods have to be considered for handling materials and products, also arrangements for storage and shipping facilities.

The modern industrial plant of 2,500 to 20,000 kw. is almost invariably complicated on account of demands for steam in processes or for the utilization of by-products, so that the electric power becomes more or less of a by-product and in many cases is developed at a cost with which a service supply company cannot compete. The mere fact that a large central station develops electrical energy at a very low cost does not determine the decision in connection with an industrial plant. The only consideration is what advantage there is in purchased power as compared with the isolated plant. Mr. Low, past-president of the American Society of Mechanical Engineers, had an editorial in *Power* which was a plea for industrial power plants to keep up with modern development and to design for economy in fuel production.

Where there is any by-product, there is the chance for maximum return, and engineering along this line has progressed steadily. Thus cement plants utilize waste gases to generate sufficient steam to operate their entire electrical equipment and provide for compressed-air requirements, the kilns using no more coal than before, and coal for the boilers being used only after a shut-down for annual repairs. A decided advance has been made also in collecting and recovering cement dust that was formerly discharged into the atmosphere. As much as 13 tons per stack per day has been thus recovered. Marked development has been made in the economical burning of wood waste, from sawdust with 15 per cent moisture to kiln-dried lumber, and this has been due mainly to analysis of the various types of furnaces.

In foundry work, mechanical molding has resulted in a more uniform product at lower cost. A recent foundry of this type has a continuous uninterrupted production of one car-wheel per minute throughout the 8-hour day. In high-pressure hydraulic machinery the problem of interruptions due to breakage of supply lines to the valves on account of vibration has been solved by spiral pipe connections designed to suit the different sizes of pipes. In all such cases, the engineer must realize the necessity of analyzing every problem, as each problem distinctly stands by itself.

Power for Steel Mills (By Wilfred Sykes, consulting engineer, Inland Steel Co., Chicago)—Probably the most important item in the development of the steel industry has been the availability of power which can be substituted for human effort, giving increased production coupled with improved working conditions and standard of living. This has been accompanied usually by a reduction in cost and selling price of the product. Figures at one plant indicate an increase in production per man of about 35 per cent in the past ten years, in spite of the elimination of the 12-hour day.

At the present time the steel industry is largely electrified. This power is used even for driving the main rolls in a large proportion of the mills and is universal for auxiliary devices. Approximately 75 per cent of the power in 1926 was generated in the mills and 25 per cent supplied from outside sources, mainly central station plants. The aggregate rating of motors in steel mills is about 3,500,000 hp., of which 1,000,000 hp. are driven by purchased power. The largest continuously rated rolling-mill motor is 9,000 hp., but where several motors drive different units of the mill the total power may be much higher. Many of the continuously running mills have constant-speed motors, but there is increasing use of adjustable-speed motors.

A characteristic of steel-mill load is considerable fluctuation in the demand for power and little correlation between the operation of the blast furnace and the power requirement. The load factor on week days will average 60 to 65 per cent, based on the maximum load, or 45 to 50 per cent when spread over a year. This is not an ideal load for internal-combustion engines, which should be operated near their rated capacity and without rapid load changes. Where gas engines have been used, therefore it has become regular practice to install about 30 per cent of the total capacity in turbo-generators to carry the peak load and regulate the system. But the overall efficiency of such a combined plant is not much in excess of that of a turbo-generating plant, while in addition to its complications the former costs much more than an all-steam plant. With boilers heated by waste gas from the open-hearth furnaces, steam generated averages 1,200 to 1,500 lb. per ton of steel produced, and usually all the steam available is used.

Future development at steel plants having blast furnaces will be in installing steam turbo-blowers and turbo-generators and in connecting these plants with central station plants, so that excess power can be delivered to or additional power taken from the latter as conditions require. For steel plants which have no blast furnaces and have central-station power available it is better to purchase power.

Appendix D. Cost Detail

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 4190 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	$ -
3.00	RAILINGS	$ 85,000
4.00	DECK	$ 250,000
5.00	OTHER	$ 150,000
		$ 485,000

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					$ -	$ -
2.10					$ -	$ -
2.15					$ -	$ -
2.20					$ -	$ -
2.25					$ -	$ -
2.30					$ -	$ -
2.35					$ -	$ -
2.40					$ -	$ -
2.45					$ -	$ -
2.50					$ -	$ -
						$ -

3.00 RAILINGS

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
3.05	Spot paint steel components of orn. Railing	5	1	LS	$ 85,000	$ 85,000
3.10					$ -	$ -
3.15					$ -	$ -
3.20					$ -	$ -
3.25					$ -	$ -
3.30					$ -	$ -
3.35					$ -	$ -
3.40					$ -	$ -
3.45					$ -	$ -
3.50					$ -	$ -
						$ 85,000

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
4.05	Seal longitudinal deck cracks on top.	20	1	LS	$ 250,000	$ 250,000
4.10					$ -	$ -
4.15					$ -	$ -
4.20					$ -	$ -
4.25					$ -	$ -
4.30					$ -	$ -
4.35					$ -	$ -
4.40					$ -	$ -
4.45					$ -	$ -
4.50					$ -	$ -
						$ 250,000

5.00 OTHER

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
5.05	Epoxy coating on the sidewalks	20	1	LS	$ 150,000.00	$ 150,000
5.10					$ -	$ -
5.15					$ -	$ -
5.20					$ -	$ -
5.25					$ -	$ -
5.30					$ -	$ -
5.35					$ -	$ -
						$ 150,000

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 4190 MAINTENANCE/STABILIZATION/PRESERVATION (M/S/P) Activity Listing and Costs

Notes:
1 Costs are presented in 2006 dollars.
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PRESERVATION COST SUMMARY

	ITEM	COSTS
1.00	SUPERSTRUCTURE	$ -
2.00	SUBSTRUCTURE	$ 5,500
3.00	RAILINGS	$ 1,200,000
4.00	DECK	$ -
5.00	OTHER	$ 110,000
		$ 1,315,500
	Mobilization @ 5% and 20% Contingency:	$ 301,000
		$ 1,616,500

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					$ -	$ -
1.55					$ -	$ -
1.60					$ -	$ -
1.65					$ -	$ -
						$ -

2.00 SUBSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
2.05	Remove graffiti	N.A.	1	LS	$ 5,000	$ 5,000
2.10	Remove debris from abutment seats	N.A.	1	LS	$ 500	$ 500
2.15					$ -	$ -
2.20					$ -	$ -
2.25					$ -	$ -
2.30					$ -	$ -
2.35					$ -	$ -
2.40					$ -	$ -
2.45					$ -	$ -
2.50					$ -	$ -
						$ 5,500

3.00 RAILINGS

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
3.05	Reconstruct ornamental railings	50	1	LS	$ 1,200,000	$ 1,200,000
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					$ -	$ -
						$ 1,200,000

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
4.05					$ -	$ -
4.10					$ -	$ -
4.15					$ -	$ -
4.20					$ -	$ -
4.25					$ -	$ -
4.30					$ -	$ -
4.35					$ -	$ -
4.40					$ -	$ -
4.45					$ -	$ -
4.50					$ -	$ -
						$ -

5.00 OTHER

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
5.05	Conduct study on longitudinal deck cracking	N.A.	1	LS	$ 25,000	$ 25,000
5.10	Conduct testing on ornamental railing	N.A.	1	LS	$ 50,000	$ 50,000
5.15	Prepare construction documents for railing	N.A.	1	LS	$ 35,000	$ 35,000
5.20					$ -	$ -
5.25					$ -	$ -
5.30					$ -	$ -
5.35					$ -	$ -
						$ 110,000

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 4190 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**	**$ -**
2.00	**SUBSTRUCTURE**	**$ -**
3.00	**RAILINGS**	**$ 20,000**
4.00	**DECK**	**$ 262,000**
5.00	**OTHER**	**$ 20,800**
		$ 302,800

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					$ -	$ -	$ -
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	ANNUAL COST
2.05					$ -	$ -	$ -
2.10					$ -	$ -	$ -
2.15					$ -	$ -	$ -
2.20					$ -	$ -	$ -
2.25					$ -	$ -	$ -
2.30					$ -	$ -	$ -
2.35					$ -	$ -	$ -
2.40					$ -	$ -	$ -
2.45					$ -	$ -	$ -
2.50					$ -	$ -	$ -
						$ -	**$ -**

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	Spot paint metal railing components	5	1	LS	$ 85,000	$ 85,000	$ 17,000
3.10	Flush railings and median with water	1	1	LS	$ 3,000	$ 3,000	$ 3,000
3.15					$ -	$ -	$ -
3.20					$ -	$ -	$ -
3.25					$ -	$ -	$ -
3.30					$ -	$ -	$ -
3.35					$ -	$ -	$ -
3.40					$ -	$ -	$ -
3.45					$ -	$ -	$ -
3.50					$ -	$ -	$ -
						$ 88,000	**$ 20,000**

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	Seal cracks	5	1	LS	$ 50,000	$ 50,000	$ 10,000
4.10	Mill and replace overlay	25	1	LS	$ 5,800,000	$ 5,800,000	$ 232,000
4.15	Flush deck with water annually	1	1	LS	$ 20,000.00	$ 20,000	$ 20,000
4.20					$ -	$ -	$ -
4.25					$ -	$ -	$ -
4.30					$ -	$ -	$ -
4.35					$ -	$ -	$ -
4.40					$ -	$ -	$ -
4.45					$ -	$ -	$ -
4.50					$ -	$ -	$ -
						$ 5,870,000	**$ 262,000**

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	Epoxy coating on sidewalks	20	1	LS	$ 150,000	$ 150,000	$ 7,500
5.10	Annual Bridge Inspection	1	1	LS	$ 5,000	$ 5,000	$ 5,000
5.15	In-depth Bridge Inspection	4	1	LS	$ 25,000	$ 25,000	$ 6,250
5.20	Underwater Bridge Inspection	5	1	LS	$ 10,000	$ 10,000	$ 2,000
5.25					$ -	$ -	$ -
5.30					$ -	$ -	$ -
5.35					$ -	$ -	$ -
						$ 190,000	**$ 20,750**