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

Bridge Number: 27004

Executive Summary

Bridge 27004 (James J. Hill Stone Arch Bridge) was built between 1881 and 1883 to carry Minneapolis Union Railroad traffic on double tracks over the Mississippi River just below St. Anthony Falls in Minneapolis, Hennepin County. It has an overall structure length of 2,100 feet, an out-out width of 28 feet, and was constructed with an 817-foot, six-degree curve at the west end. Originally the bridge had 23 limestone arches with spans ranging from 40 to 97.8 feet. In 1962 two river spans were replaced by a 196-foot steel Warren deck truss to accommodate vessels using the newly completed Upper Lock and Dam. Railroad traffic ended in 1982. Following its acquisition by Mn/DOT in 1992, it was reconfigured for less-demanding use by pedestrians and bicycles and became part of the St. Anthony Falls Heritage Trail. The bridge is located within the National Register St. Anthony Falls Historic District and is designated a National Historic Engineering Landmark.

Bridge 27004 has adequate width, load capacity, and railings to remain in less-demanding service as a pedestrian bridge. The significant issue for the long-term preservation of the bridge is the infiltration of water into the stone masonry. Activities are recommended to address water issues, with particular attention to drainage features and masonry damage resulting from water infiltration.

The recommended future use of the bridge is rehabilitation for less-demanding 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.

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Minnesota Department of Transportation (Mn/DOT)

Historic Bridge Management Plan

I - Project Introduction Bridge Number: 27004

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.

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

II - Bridge Data — Bridge Number: 27004

Date of Construction	1883
SHPO Inventory Number	HE-MPC-0176
Common Name (if any)	Stone Arch Bridge

Location

Feature Carried:	Pedestrian Trail
Feature Crossed:	Mississippi River
Descriptive Location:	St. Anthony Falls

UTM Zone:	15	NAD:	Not available
Easting:	479599	Northing:	4980854
USGS Quad Name:	Minneapolis South		
Town or City:	Minneapolis		
County:	Hennepin		

Structure Data

Main Span Type:	811	Masonry Arch - Deck	Total Length: 2100

Descriptive Information (or narrative as available)

Superstructure:	Stone masonry arch, steel Warren deck truss
Substructure:	Stone masonry
Floor/Deck:	
Other Features:	Stone parapets

Narrative:

The 2100-foot bridge, designed by Col. Charles C Smith, originally included 23 Kasota limestone arches built on St. Cloud granite piers resting on St. Peter sandstone bedrock. In 1962 two arch spans were replaced by a steel Warren deck truss. The stone-arch spans range in length from 40 to 97.8 feet. The bridge's deck is approximately 60 feet above the water. To meet the proposed Minneapolis Union Depot on the west side, the bridge was designed with an 817-foot, six-degree curve at the west end. It carried double tracks with a deck width of approximately 24.5 feet between the parapets. Since 1994 the bridge has served pedestrians and bicyclists.

Roadway Function:	Pedestrian and bicycle trail
Ownership:	State
Custodian/Maint. Agency:	State

Contractor

Designer/Engineer Col. Charles C. Smith

Significance Statement

The Stone Arch Bridge is a monumental symbol of the growth and expansion of James J. Hill's St. Paul, Minneapolis, and Manitoba Railway Company, which formed a significant portion of the Great Northern Railway and his railway empire in the Northwest. The bridge was a key element in his expansion to the Pacific, and it continues today to represent Hill's vision.

During the early 1870s, Hill was closely watching the Red River of the North that flowed north to Lake Winnipeg. Fort Garry (present-day Winnipeg) was a critical post for the Hudson Bay Company, which was trying to keep control over the Canadian fur trade but did not serve independent traders. Hill did service the individual traders, and in order to minimize this dangerous competition, Norman Kittson of the Hudson Bay Company decided to join with Hill to form the Red River Transportation Company.

Hill traveled up Red River in 1870 to investigate the cause of a French and Indian mob that had captured the Hudson's Bay Company post in Fort Garry. During that trip and others, Hill saw the rich soil of the region and noticed the St. Paul & Pacific Railroad's steady decline. Grasshoppers were plaguing the farmers, and their presence made it difficult for locomotives to get traction on the rails. Hill thought that if he could buy the railroad line then he could make a profit from it by extending it to Fort Garry. The Panic of 1873 proved the final death blow for the St. Paul & Pacific, sending it into bankruptcy and receivership. Hill saw his chance to acquire the St. Paul & Pacific and other lines in similar crises.

But first Hill needed to secure more capital. He went to Norman Kittson. They each had a little money but needed much more, so they approached Donald Smith of the Hudson Bay Company and told him their plan for making the St. Paul & Pacific a profitable line. Smith offered money and talked with George Stephen, president of the Bank of Montreal. Stephen did not support the group at first in their efforts to acquire the line, but joined them three years later in their pursuit. The four, known as "the Associates," secured legislative changes, worked with bondholders, and worked for extended dates for construction of segments of rail line that were still required for completion. In March 1978, the Associates signed an agreement to purchase bonds controlled by Dutch investors. In total, they purchased the rail line, valued at $19 million, for only $5.4 million.

In May 1879, the St. Paul, Minneapolis, and Manitoba Railway Co. formed, with James J. Hill serving as general manager. Hill aggressively upgraded and expanded this railroad network, in part by bargaining for trackage rights with Northern Pacific Railway. Hill set his sights on crossing the continent, but before that could happen he had to cross the Mississippi River.

Part of Hill's network included the Minneapolis Union Railroad, a belt line between St. Paul and St. Anthony. To provide access to a new union railroad station in Minneapolis and to bring passenger traffic from St. Paul directly into the city's downtown business district, Hill and the city of Minneapolis formed a partnership to construct a railroad bridge across the Mississippi River at St. Anthony Falls.

Hill originally wanted an iron bridge crossing the Mississippi above the Falls of St. Anthony at Nicollet Island. Bridge engineer Col. Charles C. Smith realized, however, that such a design would create a bottleneck on the river and could destabilize the eroding sandstone beneath the falls. The Falls had already been rendered unstable by the Eastman Tunnel disaster of 1869 and, if a new bridge at this location further eroded the sandstone, the Falls could collapse, causing a loss of its waterpower

resources. Smith presented Hill with a bridge design that placed the east bank bridgehead below the Falls and the west bank bridgehead running parallel to the river in order to provide a straight entry into the Union Depot.

The 2100-foot bridge, as designed by Smith, was composed of 23 Kasota limestone arches erected on St. Cloud granite piers resting on St. Peter Sandstone bedrock. The spans ranged in length from 40 to nearly 100 feet. The bridge's deck is approximately 60 feet above the water. To meet the proposed Union Depot on the west riverbank, the bridge was designed with an 817-foot, six-degree curve at the west end. It carried double tracks with a deck width of approximately 24½ feet between the parapets.

In his article, "'Hill's Folly': The Building of the Stone Arch Bridge", Ray Lowry described the materials used in the structure:

The foundations for the bridge's piers were built of solid granite hauled in from Sauk Rapids, Minnesota. All exposed work on the upper portion of the bridge was built of magnesium limestone quarried at Mankato, Minnesota, and Stone City, Iowa. Marble used for the trimming on the deck of the structure came from Bridgeport, Wisconsin. Limestone, used for the unexposed portions of the bridge, was quarried on the site. In all, 100,000 tones of stone were needed for the project and the logistics of supplying such a huge amount of material was no simple matter. From June 1882 until November 1883, not less than five marble-laden railroad cars were contracted to leave Bridgeport each and every day. During the same period, 2,000 carloads of Mankato limestone were used.

In order to bond such a huge amount of stone together, an equally large amount of mortar was required. In all, 30,554 cubic yards of various cements were used on the project. Because much of the masonry work was done during the winter, a method of preparing cement in subfreezing temperatures had to be devised. Col. Smith, the chief engineer of the project, came up with a simple solution to this problem. Eight quarts of salt were incorporated into each barrel of cement and then mixed with hot water. The salt content of the solution prevented the cement from freezing and, upon drying, the salt was simply absorbed into the pores of the stone.

The bridge was constructed between 1881 and 1883. Hill employed 600 workers who worked throughout the summer and winter (utilizing horse and steam power) to complete the bridge. The total cost was approximately $650,000.

Between 1907 and 1910, the arches were reinforced with transverse steel rods installed between the spandrel walls, which were encased with concrete fill inside the spandrels. This was presumably done to counteract bulging of the spandrel walls due to poor drainage, but also served to allow heavier loads. In 1925 the railroad tracks were widened, and the parapet walls were cut back to accommodate the increased size of trains.

In 1962, two of the original 23 spans were replaced by a 196-foot Warren deck steel truss to allow river traffic to pass upstream to north Minneapolis, as part of the "Upper Harbor" project which also included two sets of locks and dams. The straight truss was set in the curved portion of the bridge, so its width was greater: 36 feet between the centerlines of the outer beams.

In April 1965, a record flood undermined one of the piers and caused it and the two adjoining arches to sag about 14 inches. Repairs included reinforcement of the arch barrels in spans 6 & 7, and encasement of the footings for piers 5, 6, & 7. Additional steel tie-rods were installed to reinforce the spandrel walls

and many of the limestone blocks were refaced with concrete at scattered locations throughout the bridge.

In 1978, the last passenger train crossed the bridge and by 1982, the rail use had ceased. The line was officially abandoned in 1987. The Hennepin County Regional Railroad Authority purchased the bridge in 1989. Ownership was transferred to the Minnesota Department of Transportation in 1992. In 1993 the bridge was extensively remodeled for pedestrian use. A.G. Lichtenstein & Associates provided the design, and the contract was awarded to Johnson Brothers Construction.

In 1994, the bridge was rehabilitated and opened to pedestrians and bicyclists. The deck features walking and bike lanes, metal safety rails, and ornamental light fixtures. An interpretative panel and view scopes were added in 1997.

Structural repairs in 1993 included crack repair using epoxy injection and re-facing of numerous limestone blocks with a seven-inch stone veneer. To prevent future bulging of the spandrel walls due to trapped water, all of the original spandrel fill (rock ballast) was removed. A waterproof membrane was placed on the interior spandrel surfaces, and a new drainage system was installed. The spandrel area was then re-filled with aggregate and a bituminous roadway (flanked by concrete sidewalks) was placed on the bridge deck. The steel deck truss span was re-painted, and the truss bearings and expansion joints were replaced. Ornamental steel railings and light posts were installed along the entire length of the bridge.

The successful renovation and adaptive re-use of the Stone Arch Bridge has received numerous honors, including a 1995 award from the Minneapolis Heritage Preservation Commission and the Minneapolis Chapter of the American Institute of Architects, as well as a 1996 “Design for Transportation National Award” from the U.S. Department of Transportation. The Stone Arch Bridge now serves as a key link in the St. Anthony Falls Heritage Trail, connecting historic mill buildings—including two National Historic Landmarks—and archaeological sites on both sides of the river.

The American Society for Civil Engineers designated the bridge a National Historic Engineering Landmark in 1978, stating that “it is acknowledged to be one of the finest stone viaducts in the world, due to its massive masonry, lofty arches, and graceful curvature.”

The Stone Arch Bridge is a contributing element to the St. Anthony Falls Historic District under Criterion A. The bridge is eligible under Criterion C as a significant engineering example of a stone arch railroad bridge.

Historic Context

National Register Criteria A, C

References

Blegen, T.C.
1975 Minnesota: A History of the State. Second Edition. University of Minnesota Press, Minneapolis.

City of Minneapolis
2005 Minneapolis River Front Bridges Website. (www.mrdbridges.com/stoneArch.php)

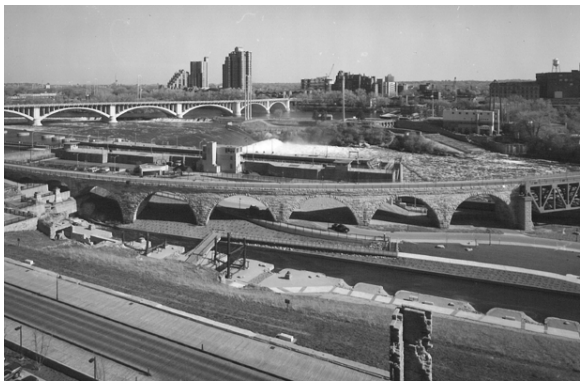
Lowry, R.
1987 Hill’s Folly: The Building of the Stone Arch Bridge. Hennepin County History, Winter.

Luecke, J.C.
1997 The Great Northern in Minnesota: The Foundations of an Empire. Grenadier Publications, St. Paul, Minnesota.

Peterson, G.O.
2003 Historic Context: The St. Paul and Pacific Railroad Main Line. Prepared for the Minnesota Department of Transportation by URS/BRW. June 2003.

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. The design of the Stone Arch Bridge includes an 817-foot, six-degree curve on the west end.

Feature 2. The original stone parapet wall was cut back in 1925 to accommodate the increased turning area needed by newer, longer cars.

Feature 3. Stone pylons mark the east approach to the bridge.

Feature 4. Stone masonry details include corbelling, decreasing course height from lower to upper courses, multiple quarry sources and varied color patterns of stones.

Feature 5. The portal arch is located at the west access road entrance, now the entry to the Upper Lock and Dam. The portal arch is different from the other arches and features a segmental arch (instead of a round arch), date stone, and pilasters.

Feature 6. Black granite marker stones are placed in west end parapet walls.

Feature 7. Metal tie rods extending through the spandrel walls were intended to counteract expansion of the spandrel walls.

Feature 8. A stone plaque, located on the north side of the west end of the bridge (near the portal arch) is inscribed with builder/owner details and date of completion.

Feature 9. The setting and location of the bridge is a character-defining feature. The bridge is situated within the National Register St. Anthony Falls Historic District. This is the view of St. Anthony Falls from the bridge.

Inspection Date	8/30/2004
Sufficiency Rating [1]	-2
Operating Rating [1,2]	0
Inventory Rating [1,2]	0
Posted Load [1]	0
Design Load [1]	7
Deficiency Rating Status [1]	N

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

Condition Codes

Deck:	7
Superstructure:	7
Substructure:	5
Channel and Prot.:	7
Culvert:	N

Appraisal Ratings

Struct. Eval.:	N
Deck Geometery:	N
Underclearances:	N
Waterway Adequacy:	7
Appr. Alignment:	7

Smart Flag Data [1] ☑ *(A check indicates data items are listed on the Bridge Inspection Report)*

Fracture Critical [1]	Y
Last Inspection Date	Y48200408

Waterway Data

Scour Code [1]: A scour evaluation has been completed for Bridge 27004 and has judged it to be scour critical. The scour action plan recommends monitoring the bridge during high flows and closing it if necessary. The bridge is to be monitored by local authorities during high flows.

Roadway Data

ADT Total:	1
Truck ADT Percentage:	
Bypass Detour Length [2]:	0

Roadway Clearances

Roadway Width [2]:	0
Vert. Clearance Over Rdwy [2]:	99.99
Vert. Clearance Under Rdwy [2]:	
Lat. Under Clearance Right [2]:	0
Lat. Under Clearance Left [2]:	0

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 27004 will not inundate during a Q100 flood event.

Accident Data

N/A

Location of Plans

Bridge Office

Existing Conditions

Available information was reviewed prior to assessing the various options for preservation of Bridge 27004 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 27004 has adequate load capacity and geometrics for pedestrian and bicycle service. The deck truss is fracture critical, but carries only a fraction of its original design load. There is potential for marine vessel impact damage to the truss, however no corrective action needs to be taken. The vertical clearance over the access road at the northwest end of bridge is minimal, providing another location where there is a potential for impact damage, albeit limited due to low traffic volume. The bridge is scour critical and should be monitored on a regular basis as well as during high river flow conditions. It has experienced scour damage in the past that has been repaired.

Structural Condition Observations:

In general the structure is in good condition. No recent deformation of the bridge was noticeable. The paint system on the deck truss is in very good condition. No significant leakage of the center trench drain system or the expansion joints at the ends of the truss was observed. Special access equipment is required to inspect and document the condition of the masonry and mortar joints. The condition of the bridge is in general conformance with the Fracture Critical Inspection Report dated August, 2004 and the Mn/DOT Bridge Inspection Report dated August 30, 2004.

Non-Structural Observations:

Unusually large amounts of drainage exiting the weep drains has stained the lower masonry courses on the south face of the bridge near the west end. A significant amount of graffiti has been painted on the bridge, primarily near the east abutment.

Date of Site Visit

April 27, 2005

Figure 1. South face weep hole staining lower masonry courses at the west end of the bridge.

Figure 2. Typical concrete repairs to stone masonry of intrados. The repairs do not appear to be new or recent. The concrete is carefully formed to represent the shape of the stone block that it replaces.

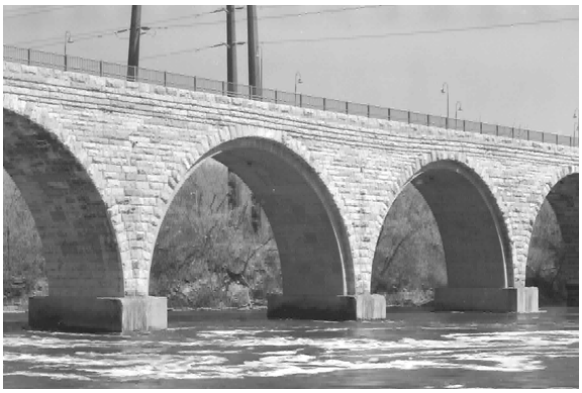


Figure 3. View showing the concrete liners of arch spans 6 and 7 and the concrete encasement of footings for piers 5, 6, and 7. Visible in the stone corbel line above the center pier is the sag caused by the 1965 flood.

Figure 4. A large portion of the south face of the east abutment has been repaired with concrete.

Figure 5. Top of the bridge is in good condition.

Figure 6. The east abutment has a significant amount of graffiti.

Overall Recommendations

With adequate geometrics and load capacity for pedestrian and bicycles, Bridge 27004 will be able to continue its current function for the 20-year planning window of this management plan. No widening or strengthening is necessary. Other less desirable preservation options were not considered.

Stabilization activities include inspection, analysis, and evaluation of components affected by water infiltration. Preservation activities address masonry problems identified through the inspection, analysis, and evaluation processes and include repointing, metal rod repair, cleaning, and crack sealing. Additional activities include long-term monitoring for any structural movement. Recommended inspection activities include ongoing attention to water-infiltration issues.

Recommended Future Use:

Rehabilitation for less-demanding use on-site

Recommended Stabilization Activities:

1. Inspect masonry and mortar at arm's length to evaluate condition and map areas in need of rehabilitation.

2. Evaluate drainage system during and immediately preceding a rain fall event to determine if the system is performing as intended. If excessive water is infiltrating the arch fill and exiting the weep holes, seal cracks and the pavement joints between the different pavement elements (stone curbs, bituminous pavement, and center trench drain). Repair or replace drainage features that are not working properly.

3. Perform a mortar analysis. The mortar should be analyzed by means consistent with the intent of the National Park Service's Preservation Brief No. 2 – Repointing Mortar Joints in Historic Masonry Buildings for the purposes of specifying the mortar mix to be used during rehabilitation. The fundamental goals of the mortar analysis should be to: a) match the historic mortar in color, texture and tooling; b) match the repointing mortar sand with the historic mortar to the extent possible; c) specify a repointing mortar of greater vapor permeability and less compressive strength than the stone masonry; and d) specify a repointing mortar as vapor permeable and with the same, or less, compressive strength as the historic mortar.

Recommended Preservation Activities:

1. Repoint, or remove and re-set, stone masonry as determined to be necessary from the field inspection. Complete repointing in a manner consistent with the National Park Service's Preservation Brief 2 – Repointing Mortar Joints in Historic Masonry Buildings.

2. Repair transverse ties and anchor rods by means of replacing damaged washers and nuts to ensure adequate bearing and painting as deemed necessary by inspection. Replacement washers and nuts should be similar in appearance to originals and painted to match originals.

3. Repair structural cracks by means of epoxy injection or sealing as deemed necessary by inspection. Use standard Mn/DOT procedures for concrete components and methods consistent with National Park Service Brief No. 1 – Assessing Cleaning and Water-Repellent Treatments for Historic Buildings for masonry elements.

4. Clean masonry. Prior to cleaning, test methods on a small area of the bridge. A simple water wash and scrubbing with natural bristle or synthetic bristle brush should be attempted first and used if found

effective. If water washing and scrubbing is found to be ineffective, more aggressive means should be tested. Limit any pressure washing to pressures no higher than 300 psi. Pay special attention to the effects of the cleaning methods on the mortar joints. Clean the entire exposed surface of the stone masonry prior to repointing if possible, using the selected cleaning method. The cleaning should be accomplished in a manner consistent with the National Park Service's Preservation Brief No. 1 – Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings.

5. Develop survey points over each substructure unit and over the crown of each arch and record a baseline survey for monitoring the future movement of the bridge.

6. Install drainage pipe extensions to those drainage pipes on the sides of the bridge which presently do not have extensions.

7. Remove graffiti from concrete components using standard Mn/DOT practices.

Projected Inspections to Monitor Bridge Condition

Routine:

1. Conduct routine inspections on an annual basis. Give special attention to the masonry mortar joints. Implement resulting recommended maintenance efforts within a 12-month period.

2. Conduct in-depth arm's length inspections as 10-year intervals. Implement resulting recommended maintenance or repair efforts within a 24-month period.

Special:

1. Conduct fracture critical inspections on a 2-year cycle.

2. Conduct underwater inspection at 5-year intervals and after high river flow events.

3. Survey the bridge at 10-year intervals to determine if settlement or other distortional movements have taken place.

Recommended Maintenance Activities

1. Spot paint truss at 10-year intervals using standard Mn/DOT procedures.

2. Repaint entire truss at 40-year intervals using standard Mn/DOT procedures.

3. Tuckpoint masonry joints as necessary at 10-year intervals utilizing the mortar recommendations from the mortar analysis described in Stabilization Activity 3.

4. Inject and/or seal cracks at 10-year intervals using standard Mn/DOT procedures for concrete components and methods consistent with National Park Service Brief No. 1 – Assessing Cleaning and Water-Repellent Treatments for Historic Buildings for masonry elements.

5. Spot paint railings at 10-year intervals using standard Mn/DOT procedures.

6. Repaint entire railing at 40-year intervals using standard Mn/DOT procedures.

7. Flush deck and railing with water annually.

8. Flush drainage system with water annually.

9. Replace pavement at 50-year intervals using standard Mn/DOT procedures.

10. Repair or replace expansion joints at 25-year intervals using standard Mn/DOT procedures.

Minnesota Department of Transportation (Mn/DOT)

Historic Bridge Management Plan

VI - Projected Agency Costs — Bridge Number: 27004

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: $ 165,900 annualized

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

Preservation activities
Superstructure: $0
Substructure: $1,425,000
Railing: $0
Deck: $0
Other: $115,000
Contingency: $356,000
Total: $1,896,000

Applicable Funding

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

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

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

The federal funding programs typically provide 80-percent federal funding and require a 20-percent state/local match. Typical eligible activities associated with these funds include replacement or rehabilitation of structurally deficient or functionally obsolete bridges for vehicular and, non-vehicular uses, painting, seismic retrofit, and preventive maintenance. If a historic bridge is relocated, the

estimated cost of demolition can be applied to its rehabilitation at a new site. It should be noted that the federal funds available for non-vehicular uses are limited to this estimated cost of demolition. However, TE funds can be applied to bridge rehabilitation for non-vehicular use.

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

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

Special Funding Note

N/A

Appendix A. Glossary of Preservation and Engineering Terms

Glossary

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix C. Current Mn/DOT Structure Inventory Report

Current Mn/DOT Bridge Inspection Report

Past Maintenance Reports (if available)

Other Reports (if available)

Mn/DOT STRUCTURE INVENTORY REPORT

Bridge ID: **27004** **PED AT ST ANTHONY OVER MISSISSIPPI R** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No. (RS 1) - 1
District 05 **Maint. Area** 5A
County 27 HENNEPIN (53)
City 2585 MINNEAPOLIS
Township
Placecode 43000
Desc. Loc. ST. ANTHONY FALLS
Sect. 23 **Tnsp.** 029N **Range** 24W
Lat. 44d 58m 54s **UTM-Y** 4980945.01
Long. 93d 15m 12s **UTM-X** 480027.09
Toll Bridge (Road) NO
Custodian STATE
Owner STATE
Inspector METRO DISTRICT
BMU Agreement No
Year Built 1883 **Yr Fed Rehab**
Year Remod. 1963
Temp.
Skew 0 **Plan Avail.** CENTRAL

* STRUCTURE DATA *

Service On PED-BICYCLE
Service Under STREAM

MN Main Span 812 MASONRY/ARCH
MN MSpn Det Def SPANDREL FILLED ARCH

MN Appr. Span 304 STEEL/DK TRUSS
MN ASpn Det Def WARREN W/VERT

Culvert Type
Barrel Length

No. Main Spans 21 **No. Appr.Span** 1
Total Spans 22 **NBI Len. (?)** YES

Main Span Length 97.8 ft
Structure Length 2,100.0 ft

Abut. Mat'l. MASONRY
Abut. Fnd. Type SPRD/ROCK
Pier Mat'l. MASONRY
Pier Fnd. Type SPRD/ROCK

Deck Width 28.0 ft
Deck Material NOT APPL
Wear Surf. Type NOT APPL
Wear Surf. Inst. Yr.
Wr. Crs/Fill Depth
Deck Membrane NONE
Deck Rebars NOT/APPL
Deck Rebars Inst. Yr.
Structure Area 58,800 sq ft
Roadway Area
Swk Width L/R
Curb Ht. L/R
Rail L/R/FHWA 40 40 NO
Ped. Fencing
Hist. Significance NATL REGISTER
Bird Nests (?) NO

* ROADWAY DATA *

Route System (Fed) MNTH
Mn. Route System MNTH
Route Number 999
Roadway Name TH 999
Roadway Function N/A
Roadway Type
Control Section 2700
BDG. Reference Point 000+00.000
Date Opened to Traffic 10-01-1994
Detour Length
Lanes 1 ON BRIDGE (1)
ADT 1 **HCADT**
ADT Year 1992
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			
Vrt. Clr. Ovr. Rd 1/Rd 2			
Max Vert Clr Rd 1/ Rd 2			
Horz U/Clr - Rd 1/Rd 2			
Lat UndClr Left/Right			
RR UndClr Vert/Lat			
Appr. Surface Width	23.0 ft		
Median Width			

* ROADWAY TIS DATA *

	TIS 1st KEY	TIS 2nd KEY
Route System		
Route Number		
High End	1,05	
Low End	1,05	
Direction		
Reference Pt.		
Interchg. Elem.		

* MISC. BRIDGE DATA *

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

* BRIDGE SIGNS *

Posted Load NO SIGNS
Traffic NO SIGNS
Horizontal NO SIGNS
Vertical NOT APPL

Def. Status ADEQ **Suff. Rating** -2.0

* WATERWAY DATA *

Drng. Area
Wtrwy. Opening 99,999 sq ft
Navigation Control PERM REQD
Nav. Vert./Hrz Clr. 23.0 ft 56.0 ft
Nav. Vert. Lift Clr.
MN Scour Code R-CRIT;MONITOR
Scour Eval. Year 2000

* INSPECTION DATA *

Inspection Date 08-30-2004 (TAVB)
Inspection Frequency 24
Inspector METRO

Condition Codes		Appraisal Ratings	
Deck	7	**Struct. Eval.**	N
Superstruct.	7	**Deck Geometry**	N
Substruct.	5	**Underclearances**	N
Chan. & Prot.	7	**Waterway Adeq'cy**	7
Culvert	N	**Appr. Alignment**	7

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	0
Pier Protection	1	**Appr. Guardrail**	0
Scour Critical	3	**Appr. Trans.**	0
Deck Pct. Unsnd.		**Appr. Term.**	N

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical	Y	48	08/2004
Pinned Asbly.			
Underwater	Y	60	12/2004
Spec. Feat.			

* PAINT DATA *

Year Painted **Pct.Unsound** 2 %
Total Painted Area
Primer Type
Finish Type

* CAPACITY RATINGS *

Design Load PED
MN
Operating Rating
Inventory Rating
Posting Veh: Semi: Dbl:
Rtg Date

* IMPROVEMENT DATA *

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

Crew Number: 7627
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 27004 PED AT ST ANTHONY OVER MISSISSIPPI R INSP. DATE: 08-30-2004

County: HENNEPIN
City: MINNEAPOLIS
Township:
Section: 23 Township: 029N Range: 24W
Span Type: MASONRY / ARCH
NBI Deck: 7 Super: 7 Sub: 5 Chan: 7 Culv: N
Appraisal Ratings - Approach: 7 Waterway: 7
Load Posting: NO SIGNS Traffic Signs: NO SIGNS Horiz. Cntl. Signs: NO SIGNS Vert. Cntl. Signs: NOT APPL

Location: ST. ANTHONY FALLS
Route: MNTH 999 Ref. Pt.: 000+00.000
Control Section: 2700 Maint. Area: 5A
Local Agency Bridge Nbr:
Open, Posted, Closed: OPEN
MN Scour Code: R-CRIT;MONITOR

Length: 2,100.0 ft
Deck Width: 28.0 ft
Rdwy. Area / Pct. Unsnd:
Paint Area / Pct. Unsnd: 2 %
Def. Stat: ADEQ Suff. Rate: UNKN

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
30	OTHER DECK	0	2	08-30-2004	58,800 SF	58,800	0	0	0	0
				07-01-2003	58,800 SF	58,800	0	0	0	0
	Notes:									
303	ASSEMBLY DECK JOINT	0	2	08-30-2004	72 LF	72	0	0	N/A	N/A
				07-01-2003	72 LF	72	0	0	N/A	N/A
	Notes: [1993] Sliding plate with strip seal at both ends truss.									
334	METAL RAIL-COATED	0	2	08-30-2004	4,200 LF	4,000	200	0	0	0
				07-01-2003	4,200 LF	4,000	200	0	0	0
	Notes: [1993] Steel railing. [1996] Grout on masonary blocks below railing have deteriorated. Block cracked through near rail bolts SW side of bridge. Paint deteriorated.									
113	PAINT STEEL STRINGER	0	2	08-30-2004	790 LF	715	50	25	0	0
				07-01-2003	790 LF	715	50	25	0	0
	Notes: Surface rust.									
131	PAINT STL DECK TRUSS	0	2	08-30-2004	395 LF	325	50	20	0	0
				07-01-2003	395 LF	325	50	20	0	0
	Notes: [1963] Steel deck truss at span 12. (Upper Saint Anthony Lock). [1993] Truss painted with zinc system. [1997] Surface rust, leaching at joints in steel ballast plate. [1998] Pack rust spreading longitudinal & transverse stringers. 2 % Unsound paint.									
145	ARCH-OTHER MATERIAL	0	2	08-30-2004	2,100 LF	0	2,050	50	0	N/A
				07-01-2003	2,100 LF	0	2,050	50	0	N/A
	Notes: Pier bases have granite blocks, arches & spandrel walls are limestone blocks. [1911] Arches reinforced with concrete backing & transverse steel tie rods. [1965] Numerous stones refaced with concrete, additional rods installed. [1993] Numerous stone blocks repaired with stone veneer, cracks in arch barrels injected with epoxy, tuckpointing in some areas. [1997] Blocks have moderate weathering, some have loose spalls. [1998] Some concrete repairs have cracking (separating slightly from stone). [2004] Underw ater Inspection found some undermining of the concrete over pour around pier #4.									
152	PAINT STL FLOORBEAM	0	2	08-30-2004	396 LF	326	50	20	0	0
				07-01-2003	396 LF	326	50	20	0	0
	Notes: Surface rust.									
310	ELASTOMERIC BEARING	0	2	08-30-2004	2 EA	2	0	0	N/A	N/A
				07-01-2003	2 EA	2	0	0	N/A	N/A
	Notes: Elastomeric bearings at truss.									
313	FIXED BEARING	0	2	08-30-2004	2 EA	2	0	0	N/A	N/A
				07-01-2003	2 EA	2	0	0	N/A	N/A
	Notes: Fixed bearings rebuilt.									
357	PACK RUST	0	2	08-30-2004	1 EA	0	1	0	0	N/A
				07-01-2003	1 EA	0	1	0	0	N/A
	Notes: [1998] Pack rust spreading longitudinal & transverse stringers.									

Crew Number: 7627
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 27004 PED AT ST ANTHONY OVER MISSISSIPPI R INSP. DATE: 08-30-2004

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
360	SETTLEMENT	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes: [1965] Piers 5, 6, & 7 and spans 6 & 7 reinforced with concrete after scour settlement of pier 6.									
361	SCOUR	0	2	08-30-2004	1 EA	0	1	0	N/A	N/A
				07-01-2003	1 EA	0	1	0	N/A	N/A
	Notes: [1993] Underwater inspection found scour holes & undermining at piers 6, 7, 8 & 9. [1997] Bridge closed during spring high water. Additional scour found at piers 7 & 9. Riprap & undermining repairs by contractor. [2004] Underwater Inspection by "Ayres Associates" found no significant changes in the structure or channel conditions.									
964	CRITICAL FINDING	0	2	08-30-2004	1 EA	1	0	N/A	N/A	N/A
				07-01-2003	1 EA	1	0	N/A	N/A	N/A
	Notes:									
966	FRACTURE CRITICAL	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
	Notes: Do Not Remove. See in-depth report for location of F/C members.									
981	SIGNING	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes:									
984	DRAINAGE	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes: [1993] Continuous trench drain along centerline, drains at pier low points.									
985	SLOPES	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes:									
986	CURB & SIDEWALK	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes: [1993] 6' Wide concrete sidewalks at both sides deck. [1996] 12 LF of transverse cracks.									
987	ROADWAY OVER CULVERT	0	2	08-30-2004	1 EA	1	0	0	N/A	N/A
				07-01-2003	1 EA	1	0	0	N/A	N/A
	Notes: [1993] Course filter aggregate spandrel fill & wearing surface (12' wide bituminous center roadway). 300 LF transverse cracks at bituminous roadway.									
988	MISCELLANEOUS	0	2	08-30-2004	1 EA	0	1	0	N/A	N/A
				07-01-2003	1 EA	0	1	0	N/A	N/A
	Notes: [1993] Ornamental deck lighting. [1998] Weeds growing along top course of masonary (should be sprayed).									

General Notes: *Bridge #27004, Year 2004
James J. Hill "Stone Arch" railroad bridge constructed in 1883. Converted to pedestrain bridge in 1993 (also used for "River City Trolleys").

See "Fracture Critical" report for futher information.

Note: Minneapolis Park Board maintains the "use area" (paving, railing, lighting, expansion joints, and trench drain). [2003] Area under bridge at the west end is old mill ruins park.

Inspectors: K.Fuhrman, V.Desens

Inspector's Signature

Reviewer's Signature / Date

Crew Number: 7627
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 27004 **PED AT ST ANTHONY OVER MISSISSIPPI R** **INSP. DATE: 08-30-2004**

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

AGREEMENT NO. 71090
DSALT

MINNESOTA DEPARTMENT OF TRANSPORTATION

CONSTRUCTION AND CONSTRUCTION ENGINEERING AGENCY AGREEMENT

WITH THE ST. ANTHONY FALLS HERITAGE BOARD FOR FUNDING PARTICIPATION IN REHABILITATION OF THE STONE ARCH BRIDGE

S.P. 94-100-12; STP ARCH (001)

EPT. MnDOT

IV. State Aid for Local Transportation

☒ A40 Original Requisition ☐ A41 Requisition Increase ☐ A45 Decrease ☐ A46 Prior Year Original ☐ A46 Prior Year Increase

Fy	Account I.D	Dept. Div	Sequence No.	Suffix	Object	Vendor	Type	Amount
4	684480	79002	41802	01	745	015 030 008	V	$2,184,000.00

Purchase Terms	Asset No.	C.CD. 1	C.CD. 2	C.CD. 3	Cost Code 4	Cost Code 5

Type of Transaction ☒ NA40 ☐ NA41 ☐ NA44 ☐ NA45 ☐ NA46

Date	Number	Entered By
8-24-93	2476	MK

This agreement made and entered into by and between the St. Anthony Falls Heritage Board, hereinafter referred to as the "Board" and the Department of Transportation of the State of Minnesota, acting by and through its Commissioner, hereinafter referred to as the "Commissioner",

WITNESSETH:

WHEREAS, Minn. Stat. Sec. 161.36 pertaining to federal aid provides that the Commissioner may act as agent for any governmental subdivision of the State in accepting federal aid for construction activities in its behalf; and

WHEREAS, The Board is proposing reconstruction of the historic Stone Arch Bridge and interpretive trail, hereinafter the "Project"; and

WHEREAS, the Project is identified in the records of the Department of

Transportation as S.P. 94-100-12, and in the records of the Federal Highway Administration as Minnesota Project STP ARCH (001), and

WHEREAS, The Board desires to obtain federal aid participation in the necessary construction and construction engineering costs in connection with the Project, and

WHEREAS, the Board additionally desires to designate the Commissioner as its agent for purposes of performing all Acts necessary to procure, accept, receive, and disburse all federal aid available for construcion and construction engineering of the Project;

WHEREAS, the Board desires further technical and engineering advice, assistance, and supervision and such other services from the Commissioner, as authorized under Minn. Stat. Sec. 161.39, in relation to the Project.

NOW, THEREFORE, IT IS MUTUALLY AGREED AS FOLLOWS:

- 1 -

The Commissioner will serve as agent of the Board for purposes of completing the Project and, as agent, undertake all activities specified in this agreement and authorized under Minn. Stat. Sec. 161.39. Specifically, the Commissioner, as agent of the Board, will procure, accept, receive, and disburse, subject to the provisions of section 5 of this agreement, all federal and Board funds made available for construction and construction engineering.

Additionally, the Commissioner, as agent for the Board, will let a contract pursuant to law for the construction of the Project. The contract will be in accordance with plans and special provisions for the Project on file in the Department of Transportation, State Transportation Building, St. Paul, Minnesota 55155, and the latest edition of Standard Specifications for Highway Construction promulgated by the Commissioner, and all amendments thereof, which said plans, special provisions and specifications are a part of this agreement by reference as though fully set forth herein.

(a) In the letting of the contract, it is hereby agreed that the following procedure shall be followed in accordance with Minnesota Law, to-wit:

The Commissioner shall cause the advertisements calling for bids on the Project to be published in the Construction Bulletin. Said advertisement or call for bids shall specify that sealed proposals or bids will be received by the Commissioner as agent of the Board. Proposals, plans, and specifications shall be made available for the inspection of prospective bidders at the office of the Department of Transportation, St. Paul, Minnesota 55155, and the advertisement shall so state.

The bids received in response to said advertisements for bids shall be opened for and on behalf of the Commissioner by a District Director of the Department of Transportation or such other employee of the Department of Transportation as may be selected by the Commissioner. Upon receipt of all the bids, the Commissioner shall duly cause all of said bids to be tabulated in accordance with law. The Commissioner shall thereupon accept the bid from the lowest responsible bidder or shall reject all bids consistent with the recommendation of the Project Liaison designated by the Board.

(b) In the payment of the contract work, it is hereby agreed that the following procedure shall be followed in accordance with Minnesota Law, to-wit:

The Commissioner shall receive the funds to be paid by the Board and the funds to be paid by the United States as federal aid funds for the Project as defined in section 3 of this agreement, and to pay therefrom when due any and all sums that may become due the contractor to whom the contract is awarded and upon final completion and acceptance of the work, to pay from said funds the final estimate to said contractor for said work. The Board agrees that any Board funds to be applied to any contract by supplemental agreement shall be deposited with the Commissioner after review and approval of the supplemental agreement pusuant to section 1(c) of this agreement.

As agent of the Board the Commissioner may enter into any agreement with the United States or any officer or agent thereof that may be required or necessary for the purpose of procuring and actually causing to be paid the federal aid funds available for the Project. The Commissioner shall perform all other further acts as agent of the Board as may be necessary or required under any law of the United States or of any regulation issued by proper federal authority in order to cause the Project to be completed and to obtain and receive the federal aid made available therefore.

(c) In the management and inspection of the contract work, it is hereby agreed that the following procedure shall be followed in accordance with Minnesota Law, to-wit:

The Commissioner is hereby granted authority to perform all construction engineering functions. The Board agrees to reimburse the Commissioner for all costs incurred therefor that are not eligible for federal reimbursement. The Commissioner shall supervise and have charge of the construction of the Project after the contract has been let. The Board agrees to furnish and assign its Secretary as Project Liaison, or in the Secretary's absence, the Park and Recreation Planner of the Park and Recreation Department of the City of Minneapolis, to perform acts specified in this agreement. A copy of a Board resolution authorizing the Secretary and the Park and Recreation Planner to act as Project Liaison in all matters is attached to this agreement.

The Commissioner agrees to furnish such personnel (including a registered professional Project Engineer to be in responsible charge of construction), services, supplies, and equipment as shall be necessary in order to properly supervise, inspect, and document said construction project. It is understood by the Board that the Commissioner cannot personally investigate and pass judgement on the various items of extra work and plan changes during the construction of the Project but that the Commissioner must delegate such duties to engineers that are employed by the Department of Transportation. The Board does hereby authorize these engineers, so delegated by the Commissioner, to enter into for and on behalf of the Board the supplemental agreements with the contractor for the performance of the extra work or work occasioned by any change in plans or construction as provided for herein.

The Commissioner may make such changes in the plans as shall be recommended by the Project Engineer. However, in the event it becomes necessary for the Commissioner or authorized agent to consider a change order to the construction contract that would increase the cost set out in the approved construction contract by more than $10,000.00, significantly alter either the external appearance or function of the bridge or constitute costs not eligible for federal reimbursement, the Commissioner shall submit the proposed change order and any supporting documentation to the Construction Project Liaison for review and approval or disapproval. The Commissioner shall be bound, subject to provisions of section 5 of this agreement, by the decision of the Project Liaison, except that failure to approve or disapprove within four (4) hours of submission shall be deemed an approval unless an extension is granted by the Commissioner or Project Engineer. Disapproval by the Project Liaison does not commit the Commissioner or the State to fund or pay for any additional cost or claim that may arise from such disapproval.

The Board agrees to reimburse the Commissioner for the full construction engineering costs and expenses of any kind or nature whatsoever arising out of, connected with, or incidental to the furnishing of such services that are not eligible for federal reimbursement. Said construction engineering costs and expenses shall include the current Mn/DOT overhead rate, subject to adjustment based on actual direct costs that have been verified by audit. The estimated cost of construction engineering including Mn/DOT overhead rate is $207,408.00 (8% of currently estimated project cost). It is anticipated that the Federal Government will pay to the Commissioner the federal aid funds in the amount of 78% of eligible construction engineering costs up to a maximum of $161,778.00. The Board agrees to advance to the Commissioner an amount equal to 22% of 8% of the successful bid amount. The Commissioner shall receive the funds advanced by the Board and shall pay therefrom, and with funds from the Federal Highway Administration costs that are incurred. If the final amount found due shall be less than the amount of funds advanced, then, and in that event, the balance of said advanced funds shall be returned to the Board without interest. If the final amount found due shall exceed the total amount of funds advanced by the Board and reimbursed by the federal government, the Board agrees to promptly pay to the Commissioner the difference between said amount found due and said amount of Board and federal funds available. Should any combination of Board and federal funds be insufficient to pay all the construction engineering costs of the Project, the Board and Commissioner agree to use their best efforts to

obtain any additional funds necessary from whatever sources are available, exclusive of the Federal County Road and Bridge Account (Fund 30).

The estimated cost of the proposed construction is $2,592,592.00. It is anticipated that the Federal Government will pay to the Commissioner the federal aid funds in the amount of 78% of eligible construction costs up to a maximum of $2,022,222.00. The Board agrees to advance to the Commissioner an amount equal to 22% of the successful bid amount and shall be deposited with the Commissioner prior to award of contract. Any construction costs not eligible for Federal reimbursement are the Board's responsibility. Should any combination of Board and federal funds be insufficient to pay all the construction costs of the Project, the Board and Commissioner agree to use their best efforts to obtain any additional funds necessary from whatever sources are available, exclusive of the Federal County Road and Bridge Account (Fund 30).

It is further anticipated that the contract to be let by the Commissioner for the construction of the Project shall provide that the contractor, as the work progresses, shall, from time to time, be paid partial payments designated in said contract as partial estimates and on the completion and acceptance of said work to be paid a final payment designated in said contract as a final estimate for all work performed.

At regular monthly intervals after the contractor has started work under the contract let by the Commissioner as agent for the Board for the construction of the Project, the Commissioner, through the Project Engineer, shall prepare partial estimates in accordance with the terms of the contract let for the Project and the procedures established by the Office of Construction, Department of Transportation. Each such partial estimate, shall be certified by the Project Engineer in charge and by the contractor performing such work. The Project Engineer shall prepare and submit to the Commissioner the final estimate data, together with the required project records in accordance with the terms of the contract let for the Project. Quantities listed on said partial and final estimates shall be documented in accordance with the guidelines set forth in the Minnesota Department of Transportation Documentation Manual for Construction Pay Quantities. After the approved final estimate has been submitted, the Board will pay to the Commissioner, from current Board funds dedicated for that purpose, such additional sums as necessary which together with Board and federal funds received for the Project will be sufficient to pay all the costs of the Project. If the final amount found due shall be less than the funds advanced by the Board together with federal funds received for the Project, then the balance of advanced funds shall be returned to the Board without interest.

When the contractor shall have completed the work on said Project, the Board or the Board's designee agrees to inspect the same and forthwith upon the completion of said

inspection, advise the Commissioner whether or not the work performed should be, by the Commissioner, accepted as being performed in a satisfactory manner. In the event the Board or the Board's designee should, after said inspection, recommend to the Commissioner that the Commissioner should not accept said work, then the Board shall at the time such recommendation is made, specify in particularity the defects in said work and the reasons why the work should not be accepted. It is further agreed that any recommendations made by the Board or the Board's designee are not binding on the Commissioner, but that the Commissioner shall have the right to determine whether or not the work has been acceptably performed and to accept or reject the work performed under the contract.

- 4 -

It is further agreed that the decision of the Commissioner on the several matters herein set forth shall be final, binding and conclusive on the parties hereto subject to the conditions set forth herein.

- 5 -

It is anticipated that the entire cost of the Project is to be paid from funds made available by the United States by way of federal aid and by the Board. If for any reason upon final voucher the United States fails to pay any part of the cost or expense of the Project, then and in that event the Board agrees to pay the same from funds dedicated for that purpose. By entering into this agreement the Commissioner does not commit to fund or pay for any additional cost or claim connected with the Project.

- 6 -

It is anticipated that the Minneapolis Park Board will assume full responsibility for upkeep, maintenance, and operation of the trail systems once construction is completed under this agreement, with the Commissioner retaining responsibility for the upkeep and maintenance of the bridge structure supporting the trail systems.

- 7 -

The Commissioner hereby permits the Board limited use of the Stone Arch Bridge property, on file with the Hennepin County Recorder's Office, for the purpose of performing the Board's Project Liaison duties.

- 8 -

The Board's Project Liaison, Board members and other persons acting on behalf of the Board during the Project shall not be considered employees of the Minnesota Department of Transportation. Any and all claims that may or might arise under the Worker's

Compensation Act of Minnesota on behalf of the Project Liaison, Board members or other persons acting on behalf of the Board during the Project, and any and all claims made by any third party as a consequence of any act or omission on the part of the Project Liaison, Board members or other persons acting on behalf of the Board during the Project shall in no way be the obligation or responsibility of the Minnesota Department of Transportation.

- 9 -

During the performance of this agreement, the Board and the Commissioner, their assignees and successors in interest agree to comply with Title VI of the Civil Rights Act of 1964, as amended. Accordingly, 49 Code of Federal Regulations (CFR) 21 through Appendix H and 23 CRF 710.405 (b) are made a part hereof by reference with the same force and effect as though fully set forth herein.

- 10 -

It is the policy of the United States Department of Transportation and the Minnesota Department of Transportation that Disadvantaged Business Enterprises as defined in 49 CFR, Part 23, shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with federal funds. Consequently, the requirements of 49 CFR, Part 23, apply to this agreement. In this regard, the Board and the Commissioner shall take all necessary and reasonable steps in accordance with 49 CFR, Part 23, to insure that Disadvantaged Business Enterprises have the maximum opportunity to compete for and perform on contracts and subcontracts. The Board and the Commissioner shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of federally funded contracts. Failure to carry out the above requirements shall constitute a breach of this agreement and may result in termination of the agreement.

- 11 -

The Board hereby assigns to the State of Minnesota any and all claims for overcharges as to goods and/or services provided in connection with this agreement resulting from antitrust violations which arise under the antitrust laws of the United States and the antitrust laws of the State of Minnesota. In the event the Commissioner recovers any funds under this paragragh, the Board shall receive its share of the recovery, minus costs and legal fees expended by the Commissioner in pursuing any and all claims.

- 12 -

The Board and the Commissioner stipulate that any facility to be utilized in performance under or to benefit from this agreement is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities issued pursuant to the requirements of the Clean Air Act, as amended, and the Federal Water Pollution Control Act, as amended. The Board and the Commissioner further agree to comply with all of the requirements of section

114 of the Clean Air Act and section 308 of the Federal Water Pollution Control Act, and all regulations and guidelines issued thereunder. The Board stipulates that as a condition of federal aid pursuant to this agreement it shall notify the Commissioner of the receipt of any advice indicating that a facility to be utilized in performance under or to benefit from this agreement is under consideration to be listed on the EPA List of Violating Facilities.

- 13 -

This agreement shall be effective upon execution by the Minnesota Department of Finance, and shall remain in effect for five (5) years from such effective date or when final payment has occurred, whichever occurs first. Such termination shall not remove any unfulfilled financial obligations of the Board as set forth herein regarding payment. The term of this agreement may be extended by a properly executed supplemental agreement.

- 14 -

Before this agreement shall become binding and effective, it shall be approved by the Board and shall also receive the approval of such state officers as the law may provide.

- 15 -

All provisions of this agreement shall be subject to limitations provided in the State of Minnesota and Federal laws.

- 16 -

The Commissioner accepts this said appointment as Agent of the Board and agrees to act in accordance herewith.

MINNESOTA DEPARTMENT OF TRANSPORTATION

Recommended for Approval

By _____

Metro Division Engineer

ST. ANTHONY FALLS HERITAGE BOARD

Recommended for Approval

By _____

Chair of the Board

By _____ 8/23/93

Deputy Commissioner

By _____

Secretary of the Board

APPROVED AS TO FORM AND EXECUTION:

By _____

APPROVED:

DEPARTMENT OF ADMINISTRATION

Original signed

By _____ AUG 24 1993

Date _____ By Gerald T. Joyce

DEPARTMENT OF FINANCE

By _____

Date 8/26/93

RESOLUTION

WHEREAS: A Construction and Construction Engineering Agency Agreement between the Minnesota Department of Transportation and the St. Anthony Falls Heritage Board is necessary in order for federal funds to be obligated for the rehabilitation of the Stone Arch Bridge project, and for other activities to be approved by the Department of Transportation and the Federal Highway Administration; and

WHEREAS: An agreement has been drafted by MNDOT and representatives of the SAFHB and legal counsel for the Board; and

WHEREAS: Said agreement details the responsibilities of the Commissioner of Transportation as the Agent of the Board, and the financial commitments of the Board and the Minnesota Department of Transportation, as well as the responsibilities of the liaison for the Board as authorized by the SAFHB on June 28, 1993.

BE IT RESOLVED THAT: THE ST. ANTHONY FALLS HERITAGE BOARD APPROVES THE CONSTRUCTION AND CONSTRUCTION ENGINEERING AGENCY AGREEMENT, AND FURTHER AUTHORIZES ITS CHAIR AND SECRETARY TO SIGN THE AGREEMENT THEREBY BINDING THE BOARD TO THE TERMS OF SAID AGREEMENT.

First Name - Last Name	Date	Yes	No

CERTIFICATION

I hereby certify that the foregoing Resolution is a true and correct copy of the Resolution presented to and approved by the St. Anthony Falls Heritage Board. The Resolution was mailed to the members of the St. Anthony Falls Heritage Board. Members indicated their approval by returning a signed resolution by mail or fax. All respondents voted to approve the Resolution. Copies of the signed approvals are on file in the office of the Board Secretary.

Irene M. Ackerberg

Chairperson

8/23/93

Date

Appendix 4

Mn/DOT Agreement No. 70524

AGREEMENT BETWEEN THE MINNEAPOLIS PARK AND RECREATION BOARD AND THE MINNESOTA DEPARTMENT OF TRANSPORTATION FOR THE USE AND MAINTENANCE OF THE STONE ARCH BRIDGE IN MINNEAPOLIS, MINNESOTA

THIS AGREEMENT is made and entered into by and between the State of Minnesota, Department of Transportation ("Mn/DOT"), acting by and through its Commissioner, and the City of Minneapolis, acting by and through its Park and Recreation Board ("Park Board").

WITNESSETH:

WHEREAS, Mn/DOT owns a stone-arch bridge ("Bridge") across the Mississippi River between Sixth Avenue Southeast on the east side of the river and Portland Avenue on the west side in the City of Minneapolis, Minnesota; and

WHEREAS, the Bridge is a historic resource to be included as part of a proposed Regional Recreational Trail System and Heritage Trail System ("Trail System") interconnecting park land owned and operated by the Park Board on both sides of the Mississippi River; and

WHEREAS, the Park Board, City of Minneapolis, Historical Society and the St. Anthony Falls Heritage Board ("Heritage Board") desire to cooperate with one another in the manner provided by Minn. Stat. §§ 138.761-.766 to fund, develop and use the Bridge as a part of the Trail System within the Central Riverfront Regional Park; and

WHEREAS, the Park Board enters into this agreement pursuant to its Cooperation Agreement adopted January 20, 1994 by the Heritage Board; and

WHEREAS, Mn/DOT has entered into a separate Agency Agreement, Mn/DOT Agreement No. 71090, dated August 24, 1993 with the Heritage Board under which Mn/DOT serves as agent of the Heritage Board for purposes of completing Bridge reconstruction work;

WHEREAS, Mn/DOT has determined that there is justification and it is in the public's interest to permit the Park Board to use the Bridge as part of the Trail System following the completion of all Bridge reconstruction work and final acceptance of the work; and

WHEREAS, under Minn. Stat. § 471.59, subd. 1 (1992), two governmental units may enter into agreement to cooperatively exercise any power common to the contracting parties and one of the participating governmental units may exercise one of its powers on behalf of the other governmental unit; and

WHEREAS, Minn. Stat. § 161.36 (1992) authorizes the Commissioner of Transportation to cooperate with the United States government and to make arrangements with any governmental subdivision of the purposes of maintaining roads and bridges financed, either in whole or in part by federal monies;

NOW THEREFORE, IT IS AGREED BY AND BETWEEN THE PARTIES AS FOLLOWS:

1. This agreement shall become effective upon final acceptance by Mn/DOT, as agent of the Heritage Board, of the work performed under State Project (S.P.)# 2700-27004. Within 10 days after such final acceptance, Mn/DOT shall send the Park Board written notice of the final acceptance date (effective date of this agreement). The anticipated completion date of the work under S.P.# 2700-27004 is in November, 1994. This Agreement shall remain in effect for a period of fifty (50) years commencing after the final acceptance of S.P.# 2700-27004. Thereafter, the parties may enter into subsequent agreements which shall be in writing and

approved by the proper state and Park Board officials.

2. Mn/DOT grants to the Park Board the exclusive right to use the Bridge as a recreational trail and as necessary for the performance of the Park Board's maintenance obligations contained in this agreement. The extent of the Park Board's permitted use is the surface of the entire length of the Bridge structure as shown in blue on Exhibit A, which is attached hereto and incorporated herein by reference. The permitted use area shall be referred to hereinafter as the "Use Area", which shall be further defined for the purposes of this agreement as follows:

> "USE AREA": Includes the surface of the entire length of the Bridge as shown and highlighted in blue on Exhibit A, including the area from the outside edge of the stone parapet on one side of the Bridge to the outside edge of the stone parapet on the other side of the Bridge as shown and highlighted in yellow on Exhibits B and C (showing a cross section of the truss), which are attached hereto and incorporated herein by reference.

3. From and after the effective date of this agreement it shall be the responsibility of the Park Board, at its own cost and expense, to provide services within and maintain the Use Area as follows:

a. repair, replace and provide routine maintenance (including, but not limited to, cleaning and painting, when applicable) of:

   1. the expansion joint glands;
   2. trail pavement, including the removal of snow, ice and debris;
   3. lighting fixtures, including lamps and electrical wiring;
   4. signage;
   5. railings, benches, trash receptacles and any other site modifications

undertaken by the Park Board on its own behalf or on behalf of others; and

6. Bridge entrance gates and fencing;

b. provide for:

1. trash pick-up and disposal; and

2. cleaning and maintenance of the trench drain.

4. In the event that the Park Board and Mn/DOT cannot agree as to the responsibility of either party for matters not covered in this agreement, the Superintendent of the Park Board and Mn/DOT's Deputy Commissioner, Bureau of Modal and Resource Management, or their respective delegates, shall meet within a reasonable time and make every reasonable effort to determine the respective responsibilites of the parties for such matters.

5. Subject to the availability of funding and subject to the provisions set forth below in Paragraphs 8-10, Mn/DOT shall be responsible during the term of this agreement for repair, structural maintenance and routine maintenance of the Bridge structure outside of the defined Use Area.

6. The Park Board shall have the authority and responsibility, at no cost to Mn/DOT, for scheduling activities, issuing permits, and collecting fees. The Park Board shall have the authority and responsibility to police and secure the Use Area and to enforce Park Board policies and applicable laws. Except to the extent that Mn/DOT, its agents or employees may be liable, the Park Board shall assume all liability for and hold Mn/DOT harmless from any and all claims for damages, actions or causes of action arising out of the performance of the Park Board's responsibilities set out in this paragraph subject to the tort liability provisions, exceptions and maximum liability limits provided in Minn. Stat. Chapter 466 (1992).

7. Any and all persons engaged by the Park Board to perform work or duties described in this Agreement shall not be considered employees of Mn/DOT and any and all claims that may or might arise under the Minnesota Worker's Compensation Act on behalf of said persons while so engaged, and any and all claims made by any third party as a consequence of any act or omission on the part of said persons while so engaged shall not be the obligation or responsibility of Mn/DOT.

8. The Park Board shall immediately notify Mn/DOT of a need for structural repair or if the Park Board is concerned about the structural safety of the Bridge. If the Park Board or Mn/DOT has a concern for the public's safety or for the safety of the Bridge and Use Area, either party may immediately close the Bridge and Use Area to public use. If structural repairs are needed or the Bridge is structurally unsafe, the Bridge shall remain closed until Mn/DOT determines that the Bridge is safe for public use. The Park Board shall not, by virtue of any improvement to or use of the Bridge, incur any financial responsibility for structural repair of the Bridge.

If Mn/DOT believes an emergency exists on the surface or in the structure of the Bridge, it may enter the Use Area without prior notice to the Park Board.

9. If Mn/DOT determines a need for structural repair to ensure continued structural safety of the Bridge as provided in paragraph 8 above, Mn/DOT may, at its discretion and subject to available funding, repair and restore the Bridge or notify the Park Board in writing that this Agreement will terminate 30 days from the date such notice is received by the Park Board. If this Agreement terminates the Bridge will cease to be available for use by the public.

Mn/DOT may, at its discretion, allow the Park Board to perform such structural repair and restore the Bridge provided that the Park Board enter into a written agreement, executed by the authorized Park Board officials, to perform said work at no cost to Mn/DOT. The agreement shall provide that Mn/DOT have prior review and approval of the scope of work. If Mn/DOT agrees to allow the Park Board to repair and restore the Bridge, this Agreement shall continue in force and the Park Board shall proceed with the completion of the repair or restoration work in a reasonable and diligent manner.

10. Throughout the duration of this Agreement, Mn/DOT may enter the Use Area to examine, test or inspect the Bridge; perform maintenance, renovations and repairs; or to protect the Bridge or persons in the event of an emergency. Mn/DOT may close the entire Bridge or any of its sections for reasonable periods for maintenance, renovation or repairs.

Mn/DOT may enter the Use Area at any time to make observations or to perform any non-destructive testing, inspections or examinations that do not affect the Park Board's activities or operations of the Use Area. The Park Board further agrees and grants Mn/DOT easements on Park Board property at both ends of the Bridge for the purpose of allowing Mn/DOT access to the Use Area at any time to perform any of its responsibilities contained in this agreement. Mn/DOT further retains the right to enter the Use Area and any portions of the Bridge for such purposes or other purposes connected with Mn/DOT's ownership of the Bridge.

Mn/DOT shall notify the Park Board prior to the performance of any scheduled maintenance, examination, inspection or testing and shall, if possible, arrange for such work to be performed when the Use Area is not open to the public. During such maintenance, inspections, testing or examinations, Mn/DOT shall conduct its activities in a manner that will not unreasonably interfere with the Park Board's operations.

11. All notices required or permitted under this Agreement shall be directed to th

Park Board: Park and Recreation Board
City of Minneapolis
400 Fourth Avenue South
Minneapolis, Minnesota 55415
Attention: Superintendent of Parks

Mn/DOT: Minnesota Department of Transportation
Metropolitan Division - Maintenance Pre-operations
1500 W. County Road B2
Roseville, Minnesota 55113-3105
Attention: Assistant Division Engineer, Maintenance Pre-operations

12. This Agreement is for the exclusive benefit of the parties. Nothing in this Agreement shall t creating or increasing any rights in any third parties against any of the parties to this Agreement.

13. The Park Board may terminate this Agreement at any time and for any reason by providing thirty (30) days written notice. Mn/DOT may terminate this Agreement upon thirty (30) days wr if at any time the Park Board fails to substantially fulfill its responsibilities as specified in this Ag if the Use Area ceases to be used as a recreational trail. Upon receipt of written notice by either Agreement and all rights hereunder shall terminate except for such rights as may have accrued to e prior to the termination.

At the expiration or termination of this Agreement, without further notice or demand, the Park Board shall deliver possession of the Use Area to Mn/DOT. The Park Board shall remove all lighting fixtures, benches, ramps, signs, machinery, equipment, furniture, or other personal property and structures of any kind hereafter installed or placed in the Use Area (the "Park Fixtures") within 180 days after the expiration or termination of this Agreement. Thereafter any fixtures abandoned by the Park Board shall become Mn/DOT's property and may be removed and disposed of at Mn/DOT's discretion. In the event that Mn/DOT incurs any costs in the removal and disposal of the abandoned fixtures, the Park Board shall reimburse Mn/DOT for any reasonable costs incurred.

14. If any of the provisions become void as a matter of law, the parties may, under advice of counsel, make such other arrangements to carry out the purpose of this Agreement.

15. This Agreement shall be construed in accordance with the laws of the State of Minnesota.

16. The Park Board may not assign, lease or make any other transfer by permit or otherwise its interests, rights or responsibilities under this Agreement or any of its provisions to any third party without Mn/DOT's prior written consent. If Mn/DOT agrees to the assignment, leasing or any other transfer of the Park Board's interests, rights or responsibilities to a third party, the Park Board shall transfer any and all of its responsibilities under this Agreement to the third party.

17. This Agreement shall be binding upon and inure to the benefit of the parties hereto, their respective successors, lessees and assigns.

IN WITNESSETH WHEREOF, the parties hereto have caused this Agreement to be executed by their duly authorized representatives upon the dates indicated below:

MINNEAPOLIS PARK AND RECREATION BOARD

By _____

Title PRESIDENT

Date 9-13-94

By _____

Title SECRETARY

Date 9-13-94

Approved as to form and execution

By _____
Board Attorney

Date 9/13/94

MINNESOTA DEPARTMENT OF TRANSPORTATION

By _____

Title Deputy Commissioner

Date 10-7-94

Approved as to form and execution
by the Office of the Attorney General

By _____

Date 10-7-94

MINNESOTA DEPARTMENT OF ADMINISTRATION

Original signed

By _____
OCT 07 1994

Date _____
By Gerald T. Joyce

MINNESOTA DEPARTMENT OF FINANCE

By _____

Date 10/7/94

S 1/2 SEC. 23, T.29, R.24

32 31 42 41

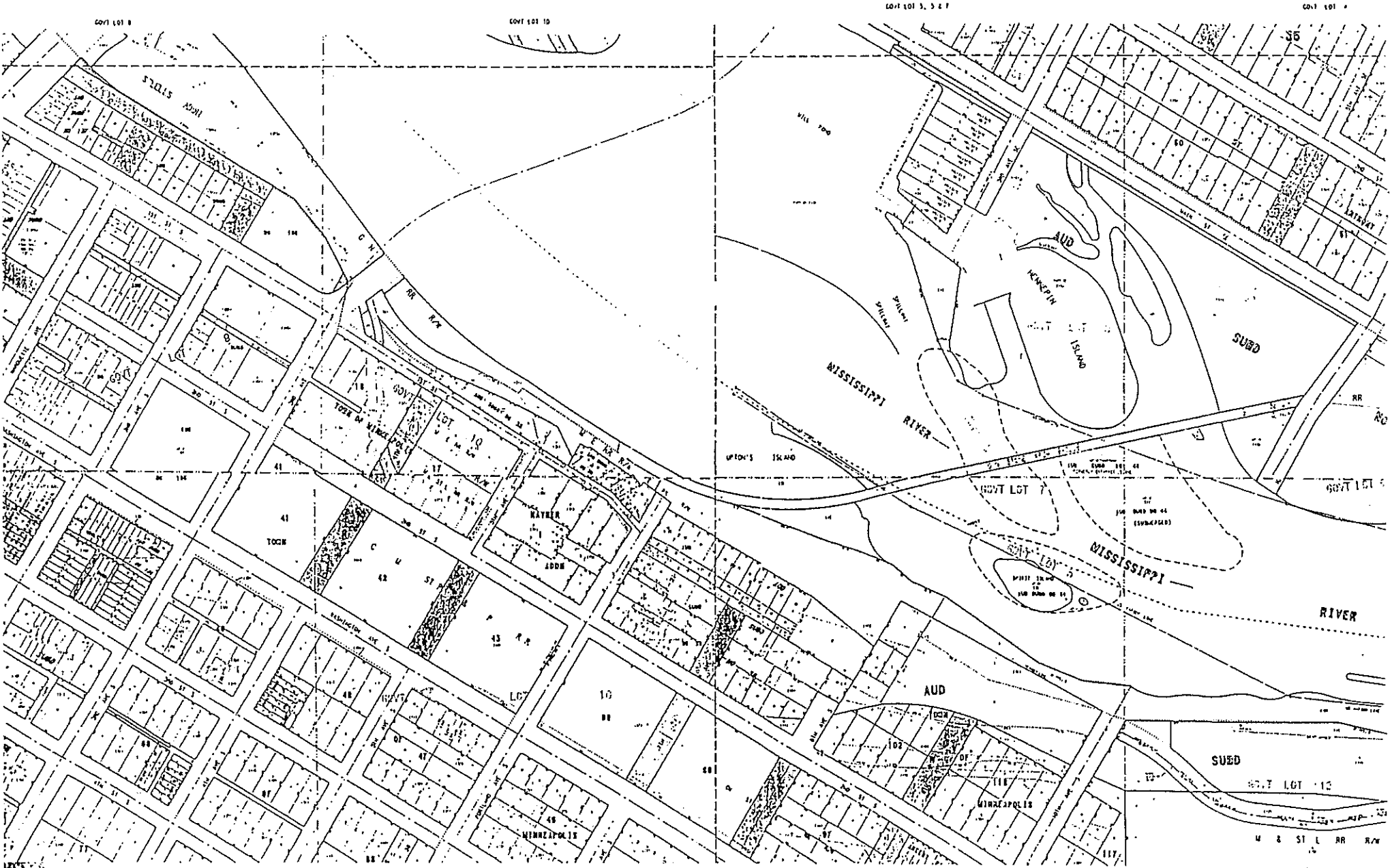


EXHIBIT A

EXHIBIT B

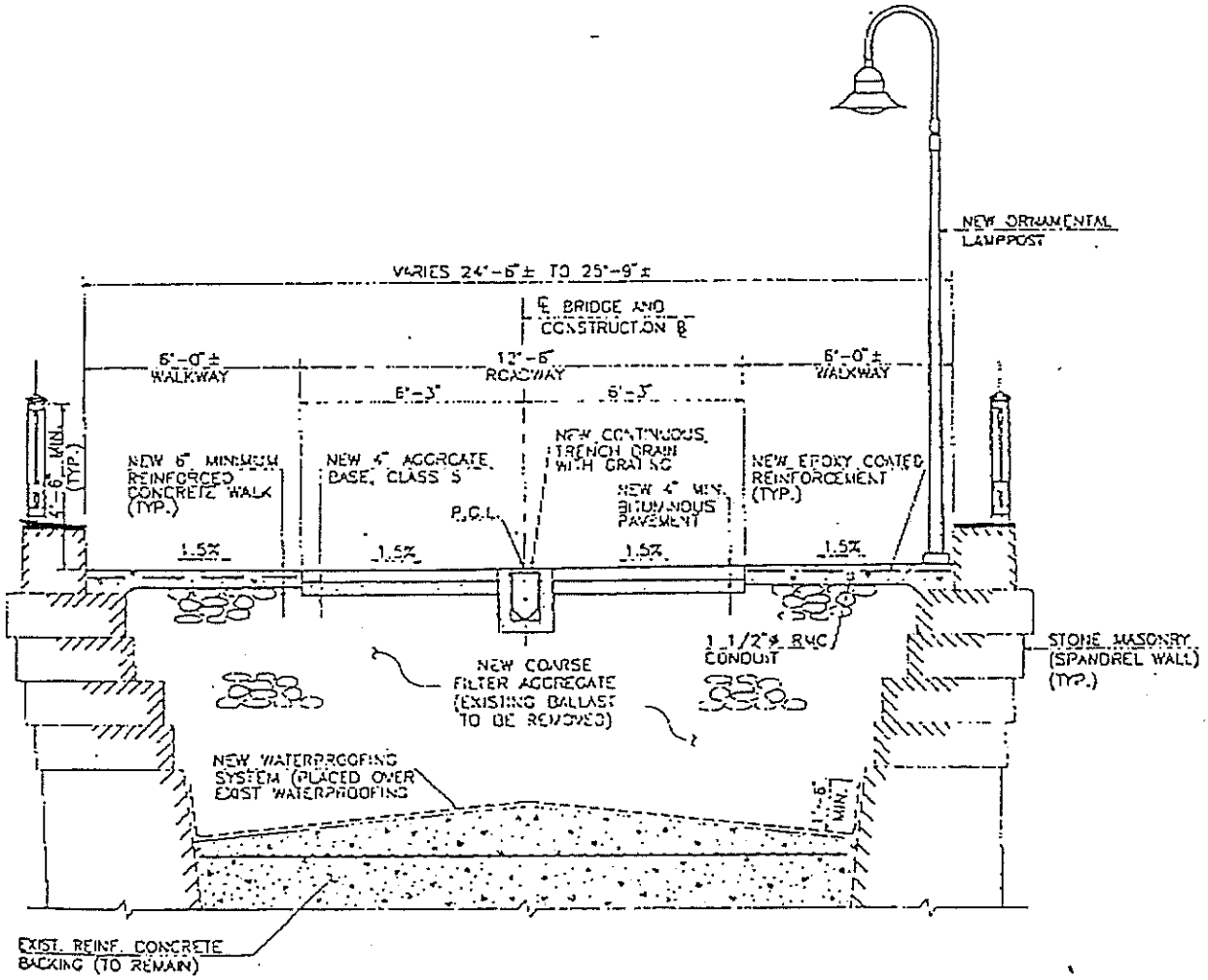
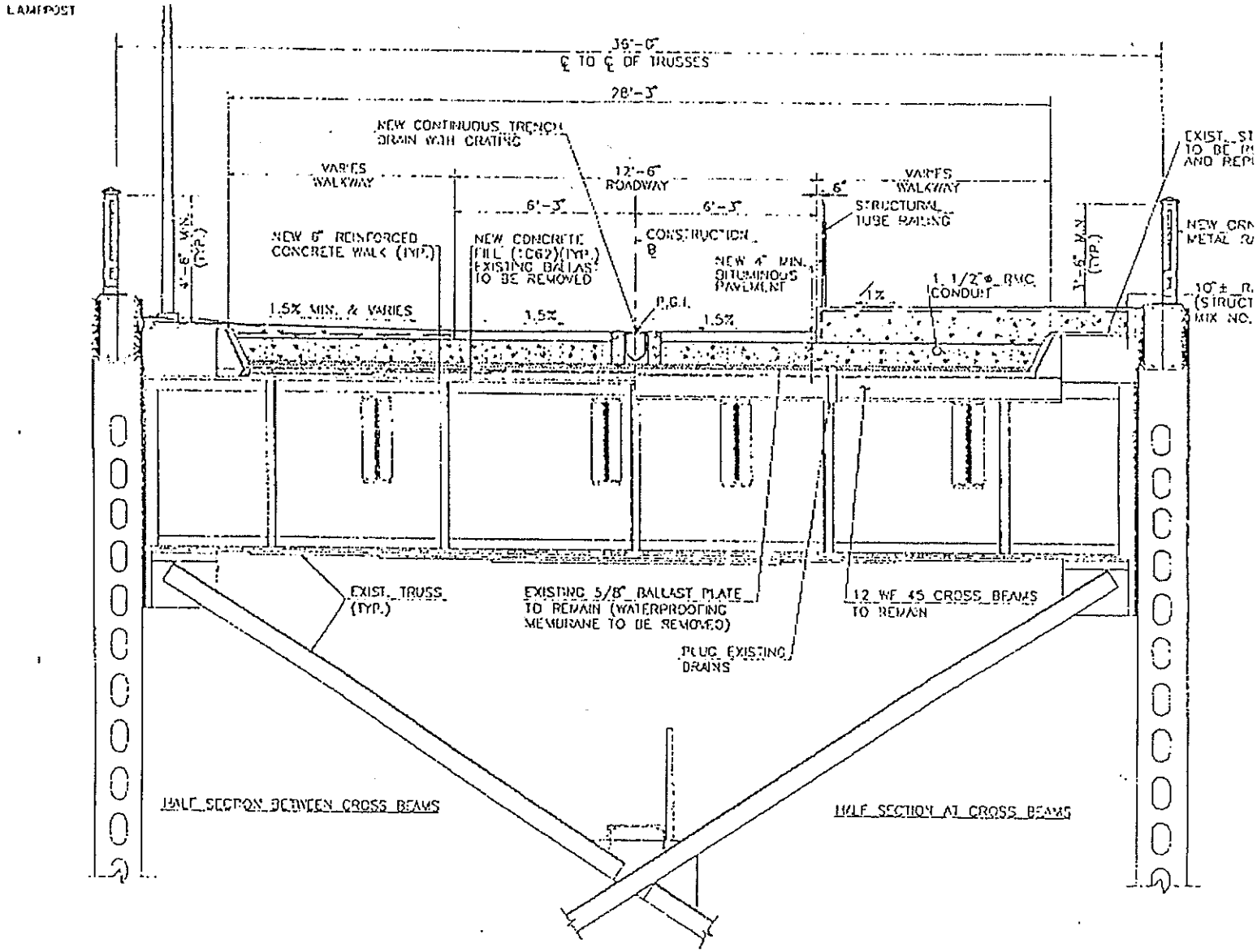

NEW ORNAMENTAL LAMPPOST
VARIES 24'-6"± TO 25'-9"±
℄ BRIDGE AND CONSTRUCTION ℄
6'-0"± WALKWAY
12'-6" ROADWAY
6'-0"± WALKWAY
6'-3"
6'-3"
NEW 6" MINIMUM REINFORCED CONCRETE WALK (TYP.)
NEW 4" AGGREGATE BASE, CLASS 5
NEW CONTINUOUS TRENCH DRAIN WITH GRATING
NEW 4" MIN. BITUMINOUS PAVEMENT
NEW EPOXY COATED REINFORCEMENT (TYP.)
P.C.L.
1.5%
1.5%
1.5%
1.5%
NEW COARSE FILTER AGGREGATE (EXISTING BALLAST TO BE REMOVED)
1 1/2"ø RMC CONDUIT
STONE MASONRY (SPANDREL WALL) (TYP.)
NEW WATERPROOFING SYSTEM (PLACED OVER EXIST WATERPROOFING
6" MIN.
EXIST. REINF. CONCRETE BACKING (TO REMAIN)

EXHIBIT C



NEW TRUSS CROSS-SECTION

SCALE: 3/8"=1'-0"

NOTES:

*) P.G.L. = PROPOSED GRADE LI

2) FOR NEW BRIDGE DRAINAGE DE SEE SHEET NOS. 7, 8 & 9.

STATE OF MINNESOTA)
COUNTY OF HENNEPIN)SS
CITY OF MINNEAPOLIS)

I, Harvey Feldman, Secretary of the Park and Recreation Board of the City of Minneapolis, in the County of Hennepin and the State of Minnesota, do hereby certify that I examined the attached Resolution No. 94-139 adopted at the Regular Meeting of the Minneapolis Park and Recreation Board held on the 7th day of September, 1994, and have carefully compared the same with the original thereof now on file in this office; and that said attached copy is a true and correct copy of said original and of the whole thereof.

IN WITNESS WHEREOF, I HAVE hereunto set my hand and affixed the corporate seal of said Minneapolis Park and Recreation Board this the 30th day of September, 1994.

Harvey Feldman, Secretary

NRPA Congress for Recreation and Parks
OCTOBER 12-16 1994

RESOLUTION NO. 94-139

ENTERING INTO AN AGREEMENT WITH
THE MINNESOTA DEPARTMENT OF TRANSPORTATION
FOR THE USE AND MAINTENANCE
OF THE STONE ARCH BRIDGE

BE IT RESOLVED THAT THE PARK AND RECREATION BOARD OF THE CITY OF MINNEAPOLIS enter into the attached agreement with the Minnesota Department of Transportation for the use and maintenance of the Stone Arch Bridge.

BE IT FURTHER RESOLVED THAT THE PARK AND RECREATION BOARD OF THE CITY OF MINNEAPOLIS authorizes its President and Secretary to execute said agreement on behalf of the Board.

Adopted by the Park and Recreation Board
in formal meeting assembled on September 7, 1994.

Thomas W. Baker, President

Approved:

Harvey Feldman, Secretary

Sharon Sayles Belton, Mayor

APPROVED BY CITY COUNCIL
SEP 3 0 1994
, 19
City Clerk

3772

STONE ARCH BRIDGE

COOPERATION

AGREEMENT

THIS AGREEMENT is made and entered into by and between the Minneapolis Park and Recreation Board (hereinafter the "Park Board"), the City of Minneapolis (hereinafter the "City"), the Minnesota Historical Society (hereinafter the "Society") and the Saint Anthony Falls Heritage Board (hereinafter the "Heritage Board") and shall be effective immediately upon being signed by a duly authorized representative for each of the aforementioned Parties.

RECITALS

WHEREAS, the City is engaged in major historic restoration and other redevelopment efforts on the Mississippi Riverfront in cooperation with the Park Board which is developing the Central Riverfront Regional Park;

WHEREAS, the Legislature of the State of Minnesota created the Heritage Board (Minn. Stat. §§ 138.761-.766), and directed it to develop a Comprehensive Interpretive Plan (hereinafter the "Plan") for the St. Anthony Falls Heritage Zone portion of the Mississippi Riverfront and to encourage the development of the historic resources within the Zone in a coordinated manner among the public and private entities involved;

WHEREAS, the Legislature further empowered the Heritage Board to provide project assistance grants to assist in the development of the historical resources identified in the Plan;

WHEREAS, one of those historic resources is the Stone Arch Bridge which is included as a part of the Heritage Trail System set out in the Plan and which connects the two banks of the Mississippi River in such a manner as to make it a critical component to riverfront restoration, redevelopment and recreation;

WHEREAS, the Minnesota Department of Transportation (hereinafter "MnDOT") acquired title to the Stone Arch Bridge pursuant to state legislation passed in 1992 (Ch.513, art. 3, sec. 77), as amended in 1993 (Ch. 266, sec. 12), for the purpose of making the Bridge available for public use;

WHEREAS, subsequent to acquiring the Bridge, MnDOT commissioned a structural assessment of the Bridge and the preparation of a bridge rehabilitation and enhancement plan for the improvements necessary to make the Bridge usable by the public, with the Heritage Board providing project assistance grants for the local match monies necessary to fund the structural assessment and the preparation of the rehabilitation and enhancement plan;

WHEREAS, the Heritage Board has entered a funding agreement with MnDOT designating MnDOT as the Heritage Board's agent for purposes of (i) completing the Bridge rehabilitation and

enhancement necessary to make the Bridge usable by the public and (ii) for procuring, accepting, receiving and disbursing all federal, state and local funds made available for Bridge construction and construction engineering;

WHEREAS, MnDOT has obtained $2.184 million of federal ISTEA funds to provide 79.42% of the funds needed to make the structural repairs and surface improvements to the Bridge identified in the Rehabilitation and Enhancement Plan and to provide for construction engineering costs;

WHEREAS, the Park Board has entered an agreement with MnDOT to use and maintain the surface portion of the Stone Arch Bridge (hereinafter the "Use and Maintenance Agreement"), for the purpose of recreation and historic interpretation by the public, as part of the Heritage Trail System within the Park Board's Central Riverfront Regional Park;

WHEREAS, the Park Board, the City, the Society and the Heritage Board desire to cooperate with one another in the manner provided by Minn. Stat. §§ 138.761-.766 to fund, develop and use the Stone Arch Bridge as a part of the Heritage Trail System within the Central Riverfront Regional Park; and

WHEREAS, the Parties wish to enter a Cooperation Agreement delineating their respective responsibilities for funding, developing and using the Stone Arch Bridge, including designating the contribution of each party to the local match monies necessary to secure the federal ISTEA funds;

NOW THEREFORE, in consideration of the payments provided for herein and of the parties' mutual promises, subject to the terms and conditions of this Agreement, the Parties agree as follows:

ARTICLE I

DEFINITIONS

The following terms have the following meaning throughout this Agreement, unless the context clearly indicates a different meaning.

Assistance Grant: A project assistance grant made by the Heritage Board pursuant to a contractual agreement for the improvement or preservation of historic resources within the St. Anthony Falls Heritage Zone.

Bridge Use Policy: The policy that governs the public and private use of the Stone Arch Bridge as a recreational and educational resource. The Bridge Use Policy is attached hereto as Appendix 1.

Central Riverfront Regional Park: Park land owned and operated by the Park Board adjoining both sides of the Mississippi River from Plymouth Avenue to I-35W, including Nicollet Island, and interconnected by a Regional Recreational Trail System of which the Heritage Trail System is a part.

Comprehensive Interpretive Plan or Plan: The plan for the interpretation of the significant historical resources in the Heritage Interpretive Zone, as approved by the Heritage

Board on June 25, 1990. The Plan is attached hereto as Appendix 2.

Construction Contract: Contract No. S93302 between the Commissioner of MnDOT and Johnson Bros. Corporation, dated September 23, 1993, for the rehabilitation of the Stone Arch Bridge and the construction of pedestrian walkways and a bicycle roadway thereon, including the Plans, Specifications and Special Provisions incorporated into the contract.

Cooperating Parties or Parties: The parties to this Agreement, namely, the Minneapolis Park and Recreation Board, the City of Minneapolis, the Minnesota Historical Society and the St. Anthony Falls Heritage Board.

Design Plan: The design concept and general recommendations for the Heritage Trail System as approved by the Heritage Board on August 12, 1991 and on file with the Secretary for the Heritage Board.

Funding Agreement: The Construction and Construction Engineering Agency Agreement No. 71090, dated August 24, 1993, between MnDOT and the Heritage Board specifying the financial contribution of the Heritage Board to the local match monies necessary to secure Federal ISTEA funds for construction and construction engineering activities and, in addition, subjecting certain change orders to the Construction Contract to review and approval by the Construction Project Liaison designated by the Heritage Board. In entering the Funding Agreement attached

hereto as Appendix 3, the Heritage Board shall act for and on behalf of the Parties to this Agreement.

Heritage Zone: The land and water area including air rights that begins at the intersection of Second Street North and Plymouth Avenue, crossing the Mississippi River on Plymouth Avenue; thence along the East Bank of the Mississippi River; thence northeasterly on Hennepin Avenue to University Avenue; thence easterly on University Avenue to I-35W; thence southwesterly across the river to Second Street South; thence along Second Street South and Second Street North to the point of beginning.

Heritage Trail System: The system of trails interconnecting the historic resources within the Heritage Interpretive Zone, as set out in the Comprehensive Interpretive Plan.

Use and Maintenance Agreement: The Agreement between the Park Board and MnDOT providing for the use and maintenance of the surface portion of the Stone Arch Bridge by the Park Board as a part of the Heritage Trail System. The Use and Maintenance Lease Agreement is attached hereto as Appendix 4.

Rehabilitation and Enhancement Plan: The plans, specifications and estimates for incorporation into the construction contract, as approved by MnDOT and the Heritage Board, for rehabilitating the Stone Arch Bridge structure and for enhancing the Bridge surface to make it usable by the

public. The Rehabilitation Plan is on file in the Department of Transportation, 395 State Transportation Building, St. Paul, Minnesota 55155.

Regional Recreational Trail System: All those paths for walking and biking within the Central Riverfront Park and encompassing the Heritage Trail System.

ARTICLE II

PURPOSE

The purpose of the Parties in entering this Agreement is to fund, develop and use the Stone Arch Bridge as a part of the Heritage Trail System in a cooperative, mutually acceptable manner consistent with the Comprehensive Interpretive Plan for the St. Anthony Falls Heritage Zone.

ARTICLE III

MUTUAL COMMITMENTS AND SATISFACTION

As set out in this Agreement, each of the Cooperating Parties commits certain resources to the development and use of the Stone Arch Bridge. Such contribution on the part of each party is conditioned upon a commitment by each other party to develop the Stone Arch Bridge as a part of the Heritage Trail System within the Central Riverfront Regional Park. Such contributions are further conditioned upon each party's commitment to use the Stone Arch Bridge in a manner consistent with the Bridge Use Policy. By entering this Agreement, each party makes such a commitment to all other parties.

ARTICLE IV

USE AND MAINTENANCE AGREEMENT

The Parties acknowledge the terms and conditions set forth in the Use and Maintenance Agreement between the Park Board and MnDOT. In the event the terms of this Cooperation Agreement, as they pertain to the Park Board, conflict with the terms of the Use and Maintenance Agreement, the terms of the Use and Maintenance Agreement will govern the conduct and responsibilities of the Park Board. Nothing in this Agreement is intended to relieve or in any way negate the responsibilities or liabilities undertaken by the Park Board pursuant to the Use and Maintenance Agreement.

ARTICLE V

BRIDGE MODIFICATIONS

The Parties agree to certain modifications and the installation of certain fixtures and accessories on or above the Bridge surface and at the approaches to the Bridge, according to the following terms and conditions:

1. The modifications and installations shall be consistent with the character and intentions set out in the Design Plan and, more particularly, with the plans, specifications, price and compensation set out in the Rehabilitation and Enhancement Plan and the Construction Contract.
2. Unless otherwise agreed by the Parties, total expenditures by the Parties for the modifications and

installations to be made pursuant to this Agreement shall not exceed the maximum price and compensation contained within the Construction Contract. To cover such costs, $100,000 has been contributed by the City, $100,000 by the Park Board, and $401,703 by the Heritage Board as local match monies to secure the $2.184 million federal ISTEA funds obtained by MnDOT to implement the Rehabilitation and Enhancement Plan. The contributions by the City and the Park Board shall be made to the Heritage Board which shall enter the necessary Funding Agreement with MnDOT to contribute up to $601,703 in local match monies.

3. The Heritage Board's own contribution of $401,703 shall be in the form of an Assistance Grant.

4. The structural rehabilitation and surface enhancements to the Bridge shall be undertaken by Johnson Bros. Corporation, the contractor chosen by MnDOT, pursuant to the Construction Contract.

5. The Construction Contract and any proposed change orders thereto shall be subject, among the Parties to this Agreement, to the following review and approval process: the Secretary of the Heritage Board shall serve as the Construction Project Liaison with MnDOT and the Park and Recreation Planner for the Park Board shall serve as the alternate to the Secretary; the Park Board, the City and the Society shall each appoint

a designee to serve in an advisory capacity to the Secretary of the Heritage Board in the review of the construction contract and any proposed change orders thereto; prior to deciding upon the acceptability of the Construction Contract or any change order thereto, the Secretary of the Heritage Board or, in the Secretary's absence, the Park and Recreation Planner shall consult collectively, whenever possible, with the designees of the City, the Park Board and the Society.

6. The Parties shall make all reasonable and necessary efforts in order to allow the construction activities described above, to proceed efficiently and expeditiously, including the review of any proposed change orders within the time allowed therefor in the Funding Agreement.

7 The Tenant Fixtures identified in the Use and Maintenance Agreement as removable by the Park Board at the expiration or termination thereof shall, among the Parties hereto, be considered the property of the Park Board.

ARTICLE VI

BRIDGE MAINTENANCE

The following provisions shall govern the maintenance of the Bridge for the term of this Agreement:

1. As provided by the Use and Maintenance Agreement, the Park Board shall be responsible for providing routine maintenance, at its own expense, to those portions of the Bridge, including the approaches thereto, which are used as a part of the Heritage Trail System within the Central Riverfront Park.

2. Specifically, the Park Board shall have responsibility, financial and otherwise, for routine maintenance of the:

   a. Bridge surface, including pavement repair and snow removal;

   b. Bridge lighting;

   c. Bridge signage;

   d. Bridge railings, benches, trash receptacles and other site modifications undertaken in order to use the Bridge as part of the Heritage Trail System; as well as

   e. Responsibility for trash pick-up and disposal.

3. The Parties further agree that the Park Board shall assume no special responsibility, financial or otherwise, for extraordinary maintenance and replacements by virtue of having accepted full responsibility for the routine maintenance identified in Paragraph 2, above. Further, no Party hereto shall, by virtue of any financial contribution or use of the Bridge, incur

any financial responsibility for the on-going upkeep and maintenance of the Bridge structure supporting the trail system, such responsibility to be borne solely by MnDOT as provided in Paragraph 6 of the Funding Agreement.

ARTICLE VII

BRIDGE USE

The following provisions shall govern the use of the Bridge during the term of this Agreement:

1. The Bridge Use Policy shall govern all public and private access to, and activities on the Bridge, both scheduled and non-scheduled.
2. Amendments to the Bridge Use Policy may, from time-to-time, be proposed and adopted in the manner provided for within the Policy.
3. The Park Board shall have the responsibility and sole authority for administering the Bridge Use Policy, including scheduling activities, issuing permits, collecting fees where permitted by the Bridge Use Policy, and providing adequate policing or other security to enforce the Bridge Use Policy and provide for the general safety of those using the Bridge and the Bridge approaches, as provided for within the Use and Maintenance Agreement.
4. With respect to programmatic activities on the Bridge, and subject to Paragraph 3 above, the Park Board shall

have primary responsibility for planning and use of the Bridge as a recreational resource; similarly, and in accordance with Minn. Stat. 138.761-.766, the Society shall have primary responsibility for planning and use of the Bridge as it relates to public education concerning the history, heritage and cultural significance of the Bridge.

ARTICLE VIII

LIABILITY AND INDEMNIFICATION

1. Except as provided in Paragraphs VIII (2) and (3) below, the Park Board shall indemnify, hold harmless and defend all other Parties and their officers, agents and employees from any and all claims, damages and liability of any kind arising from the use of the Stone Arch Bridge as a part of the Heritage Trail System.
2. The City shall indemnify, hold harmless and defend all other Parties and their officers, agents and employees from any and all claims, damages and liability of any kind arising out of any negligent or wrongful acts, errors or omissions of the City, its agents, employees or subcontractors in performing work or while engaged in activity in connection with the use of the Stone Arch Bridge as a part of the Heritage Trail System.
3. The Society shall indemnify, hold harmless and defend all other Parties and their officers, agents and

employees from any and all claims, damages and liability of any kind arising out of any negligent or wrongful acts, errors or omissions of the Society, its agents, employees or subcontractors in performing work or while engaged in activity in connection with the use of the Stone Arch Bridge as a part of the Heritage Trail System. Upon the request of the Park Board or City, the Society shall provide the requesting Party with a certificate of insurance and, further, name the requesting Party as an insured party under any policy providing the Society with coverage for any claims, damages or liability arising in the manner described in the preceding sentence.

ARTICLE IX

TERM AND TERMINATION

The term of this Agreement shall commence with its signing by duly authorized representatives for all the Parties and terminate with the termination of the Use and Maintenance Agreement between the Park Board and MnDOT. The Park Board agrees that within five days of having received notice of termination from MnDOT, it will mail a copy of such notice to each Party. Further, to the extent the Park Board can, on its own initiative, terminate the Use and Maintenance Agreement, it agrees not to do so without having first obtained the written consent of the Parties.

ARTICLE X

NON-ASSIGNMENT OF AGREEMENT

Without the prior written consent of all Parties, no Party may assign this Agreement or any rights thereunder or interests therein to any person, partnership, corporation, subsidiary or any other entity.

ARTICLE XI

SEVERABILITY OF PROVISIONS

In the event that any term or provision of this Agreement, including any Appendix hereto, is held invalid or unenforceable by a court of competent jurisdiction, the remainder of this Agreement shall not be affected thereby and each term and provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law.

ARTICLE XII

ENTIRE AGREEMENT CONTAINED WITHIN

The provisions of this Agreement and all Appendices attached hereto constitute the entire Agreement among the Parties and supercede all proposals, oral or written, and all previous and current negotiations and other communications among the Parties.

ARTICLE XIII

AMENDMENTS TO AGREEMENT

No modification of this Agreement, except as otherwise provided herein, shall be binding upon the Parties unless made

in writing and executed on behalf of each Party by a duly authorized representative.

ARTICLE XIV

CAPTIONS NOT PART OF AGREEMENT

The captions in this Agreement are for convenience only and shall not constitute a limitation of any terms.

ARTICLE XV

NOTICE TO PARTIES

All notices required hereunder shall be deemed given when deposited in a United States mail, first class postage prepaid and addressed to the other Party at the address set forth below or at such other address as may be hereinafter designated in writing by any party to all other parties:

Superintendent
Minneapolis Park and Recreation Board
200 Grain Exchange
400 South Fourth Street
Minneapolis, MN 55415

Mayor of Minneapolis
City Hall
Room 331
350 South Fifth Street
Minneapolis, MN 55415

Director, Minnesota Historical Society
345 Kellogg Boulevard West
Saint Paul, MN 55102-1906

Chair
St. Anthony Falls Heritage Board
345 Kellogg Boulevard
St. Paul Boulevard West
Saint Paul, MN 55102-1906

ARTICLE XVI

MINNESOTA LAW TO GOVERN

This Agreement shall be interpreted in accordance with and governed by the Laws of the State of Minnesota.

IN WITNESS WHEREOF, the undersigned have subscribed their names as of the date so shown.

MINNEAPOLIS PARK AND RECREATION BOARD

Date: 10/26/94

By Thomas W. Baker
Its President

Date: 10/26/94

By Harvey Feldman
Its Secretary

CITY OF MINNEAPOLIS

Date: _____

By Sharon Sayles Belton
Mayor

Approved as to form and execution:

Assistant City Attorney

Attest Merry Keefe
City Clerk

Countersigned Robert Lee, 10/27/94
Asst. Finance Officer

MINNESOTA HISTORICAL SOCIETY

Date: 10-18-94

By Nina M. Archabal

Its Director

Date: 10/18/94

By

Its Contracting Officer

ST. ANTHONY FALLS HERITAGE BOARD

Date: 10/31/94

By Judith W Doermann

Its Secretary

43080G
09/12/94

BRIDGE USE POLICY FOR THE STONE ARCH BRIDGE

I. USE POLICY

This Bridge Use Policy is to govern and enhance use of the Stone Arch Bridge as a trail for the benefit of the general public and to facilitate its management for the purposes of recreation and historic interpretation, as part of the St. Anthony Falls Heritage Trail within the Minneapolis Park and Recreation Board's Central Riverfront Regional Park.

This Bridge Use Policy governs all public and private access to, and the programmatic use of, the Stone Arch Bridge and its approaches as a recreational and educational resource. This Policy, as approved by the Minneapolis Park and Recreation Board (hereinafter referred to as the "Park Board"), the St. Anthony Falls Heritage Board (hereinafter referred to as the "Heritage Board"), the Minnesota Historical Society (hereinafter referred to as the "Society"), and the City of Minneapolis (hereinafter referred to as the "City"), forms an Appendix to the Cooperation Agreement between the parties hereto, setting out governmental roles in facilitating use of the Stone Arch Bridge as a public recreational and historic resource.

II. DEFINITION OF TERMS

Stone Arch Bridge: A bridge structure built by railroad magnate James J. Hill in 1883 of granite and limestone for the purpose of carrying trains, passengers and freight in and out of the City of Minneapolis. It remains a landmark on the riverfront and is a key recreational and historic resource in the development of the Central Riverfront Regional Park and St. Anthony Falls Heritage Trail. The Stone Arch Bridge is referred to hereinafter as the "Bridge."

Public Use: Public use includes any use of the Bridge by the public in a manner permitted by this policy or by any permit issued hereunder.

Special Use: A Special Use is any activity which can limit use and enjoyment of the Bridge by the general public.

Exclusive Use: An Exclusive Use is a Special Use in which the activity requires exclusive use of the Bridge for any period of time.

Special Use Permit: A permit issued for a Special Use of the Bridge following the procedures set forth herein.

Concessionaire Permit: A permit issued to an individual or organization permitting use of the bridge and/or its approaches for the purpose of selling goods or services to the public.

Permitted Special Use: Any Special Use for which a Special Use Permit has been obtained.

III. GUIDELINES AND GUIDELINES ADMINISTRATION

Use of the Stone Arch Bridge shall be governed by the Minneapolis Park and Recreation Board Code of Ordinances, which are made a part hereof by reference.

In addition to that Code of Ordinances, the Bridge Use Policy set forth herein and the guidelines promulgated by the Park Board to implement the Policy, use of the Bridge shall be governed by the overriding principles that all users must operate in such a manner as to not detract from the enjoyment of the facility by others and no motorized vehicles will be permitted to operate on the Bridge other than as provided by state law or, in the absence of state law, by Special Use Permit.

A. Administration of Bridge Use Policy

The Park Board shall have the sole responsibility and authority for administering this Bridge Use Policy consistent with the provisions hereof, including scheduling activities, issuing permits, collecting fees where permitted by this Policy, and providing adequate policing or other security to enforce the Policy and provide for the general safety of those using the Bridge. The Park Board shall have overall responsibility for the programming and use of the Bridge except to the extent that responsibility is restricted by the provisions of this policy.

1. Within 120 days after the effective date of this policy the Park Board shall prepare and distribute to the parties hereto a set of guidelines it intends to implement in order to fulfill its

obligations to provide for the safety of the public while using the Bridge.

2. The Park Board may, from time to time amend the guidelines promulgated under the above paragraph and upon such amendment, shall notify the parties hereto.

3. Within 120 days after the effective date of this policy, the Society shall prepare and distribute to the parties hereto a written plan for the public education and historic activities program it intends to operate in order to fulfill its obligations to provide for public education concerning the St. Anthony Falls Heritage Zone.

4. The Society may, from time to time amend the guidelines promulgated under the above paragraph and upon such amendment, shall notify the parties hereto.

B. Oversight Committee

An Oversight Committee consisting of three members of the St. Anthony Falls Heritage Board or their designees; one each representing the City, the Society, and the Park Board; shall be appointed within 30 days after the effective date of this Policy. The Oversight Committee may appoint one or more designees to carry out its functions as set forth herein. The Committee shall function for two (2) years thereafter for the following purposes:

1. To monitor the use of the Bridge and recommend amendments to this Policy which ensure a balanced use of the Bridge for full enjoyment of its recreational and historic value.

2. To review and make recommendations on the guidelines established by the Park Board and Society as set forth above in Paragraphs A.1. and A.3., respectively.

3. To review and make recommendations on Special Use Permits for the Bridge as set forth in Paragraph C.2. below.

C. Special Use Permits

Special Uses of the Bridge will not be permitted until a Special Use Permit has been obtained. The Park Board

shall determine whether a particular activity constitutes a Special Use, and shall have the right to deny Special Use Permits as necessary to provide for the public safety and ensure a balanced use of the Bridge. Within 120 days after the effective date of this agreement, the Park Board shall draft and circulate to the parties hereto guidelines which it intends to follow in determining what constitutes a Special Use for the purposes of this Policy.

1. Permits by Staff

(a) Permits for Special Uses which are not Exclusive Uses may be granted by the Park Board. Such permits must be requested a minimum of seven (7) days in advance. Permits shall be granted for activities which are consistent with this Policy and which do not significantly inhibit or reduce the enjoyment of the Bridge by others.

(b) Exclusive Use Permits may be granted by the Park Board during periods of low and moderate use for periods not exceeding four hours. Exclusive use permits may require the retention of Park Security Personnel at the established hourly rate with a minimum of four (4) hours. Exclusive Use Permits must be requested a minimum of fourteen (14) days in advance.

(c) The deadline for requesting Special Use Permits may be waived by the Park Board if such waiver would serve to advance the purposes set forth in this policy.

2. Exclusive Use Permit Review by Oversight Committee

Exclusive Use permits for periods of high use or exceeding four hours may be granted by the Park Board only after review and recommendation by the Oversight Committee. Requests must be received by the Park Board at least 90 days in advance of the event for which the permit is requested. This advance notice requirement may be waived by the Park Board, which shall notify the Oversight Committee.

The Park Board, within 120 days after the effective date of this agreement will develop and distribute to the parties guidelines which it intends to apply in defining periods of high use for application of this provision. Those guidelines may be modified by the Park Board from time

to time and such modifications shall be distributed to the parties hereto.

D. Fees and Charges for Use of the Bridge

The Bridge will be operated as a public facility. As such there will be no charges for its use. However, permits issued by the Park Board will be assessed a charge in accordance with the applicable Minneapolis Park and Recreation Board Schedule of Fees and Charges. Exclusive Use Permits granted by the Minneapolis Park and Recreation Board after review and recommendation by the Oversight Committee shall have charges individually negotiated. None of the Parties to the Cooperation Agreement will be assessed a permit charge. For activities for which a charge is assessed, the revenue-sharing will be individually negotiated.

Charges for personnel, administration and equipment will be assessed in accordance with the applicable Minneapolis Park and Recreation Board Schedule of Fees and Charges. Parties to the Cooperation Agreement shall be subject to charges for equipment and personnel furnished by the Park Board.

E. Concessionaire Permits

Concessionaire Permits to operate on the Bridge or its approaches may be granted by the Park Board with the concurrence of the Oversight Committee. It will be the intent in granting such permits that the public experience in enjoying the Bridge for recreational and historic interpretive activities be enhanced. Ordinarily, concessionaires who can provide the equivalent public service at another location in the vicinity, will not be given a Concessionaire Permit to operate on the Bridge. Charges for Concessionaire Permits will be individually negotiated.

IV. RECREATIONAL AND EDUCATIONAL ACTIVITIES

With respect to programmatic activities utilizing the Bridge, the Park Board shall have the sole responsibility for scheduling activities, issuing permits, collecting fees where permitted by the Bridge Use Policy, and providing adequate policing or other security to enforce the Bridge Use Policy and provide for the general safety of those using the Bridge. In furtherance of these responsibilities, the Park Board shall have primary planning and use of the Bridge as a recreational resource.

The Society shall have the right and responsibility for conducting public education and historic interpretation activities relating to the Bridge and the St. Anthony Falls Heritage Zone, in accordance with Minn. Stat. 138.761-.766. In the interest of furthering such activities by the Society, this Policy shall be interpreted in favor of giving the Society broad access to the Bridge and its access areas.

A. Regularly Scheduled Activities

In the event that the Society or other program providers engage in a regular, scheduled program of group walks or similar activities, Special Use Permits for such activities may be issued on an annual basis. The Park Board shall not issue Exclusive Use Permits which would conflict with the regularly scheduled activities without obtaining the consent of the program provider.

Group Walks

The Society or other parties intending to conduct group walks over the bridge for recreational, educational and interpretive purposes, but which are not a regularly-scheduled activity, shall be required to obtain Special Use Permits for such walks. The size of groups shall be reasonably limited by the program provider so as not to prevent other members of the public from using the Bridge at the same time.

C. Occasional Special Activities

The Society and other parties may conduct group recreational, educational or interpretive activities on the Bridge or its approach areas other than regular, scheduled walks. In such cases, the parties shall notify the Park Board of their plans. If neither an Exclusive Use Permit, nor a Special Use Permit which would preclude the party's activity, has been issued for the same date and time, the party's activity may be conducted as planned. A Special Use Permit shall be required for such activities.

D. Exclusive Use Activities

The parties to this Use Policy may conduct recreational, educational or interpretive activities on the Bridge or its approach areas which require the Exclusive Use thereof. In such cases, the parties shall notify the Park Board of their intention to do so at least 30 days in advance of the planned event. If the event does not conflict with other events for which Special Use permits

have been granted or applied for at the time of the parties' request, the Park Board shall issue a Special Use Permit for the event.

V. AMENDMENTS TO BRIDGE USE POLICY

Amendments to this Policy may be proposed by the Oversight Committee within the first two (2) years of the effective date of this Policy. Additionally, amendments to the Policy may from time-to-time, be proposed by the parties to this Use Policy and once approved by all parties, the Amendments shall be effective.

4349G
09/12/94

Appendix D. Cost Detail

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 27004 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	$ -
4.00	DECK	$ -
5.00	OTHER	$ 40,000
		$ 40,000

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					$ -	$ -
3.10					$ -	$ -
3.15					$ -	$ -
3.20					$ -	$ -
3.25					$ -	$ -
3.30					$ -	$ -
3.35					$ -	$ -
3.40					$ -	$ -
3.45					$ -	$ -
3.50					$ -	$ -
						$ -

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
4.05					$ -	$ -
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	Arm's Length Masonry Inspection and Report	N.A	1	LS	$ 30,000.00	$ 30,000
5.10	Evaluate drainage system	N.A	1	LS	$ 2,000.00	$ 2,000
5.15	Mortar Analysis	N.A	1	LS	$ 8,000.00	$ 8,000
5.20					$ -	$ -
5.25					$ -	$ -
5.30					$ -	$ -
5.35					$ -	$ -
						$ 40,000

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 27004 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.

PRESERVATION COST SUMMARY

	ITEM	COSTS
1.00	SUPERSTRUCTURE	$ -
2.00	SUBSTRUCTURE	$ 1,425,000
3.00	RAILINGS	$ -
4.00	DECK	$ -
5.00	OTHER	$ 115,000
		$ 1,540,000
	Mobilization @ 5% and 20% Contingency:	$ 356,000
		$ 1,896,000

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					$ -	$ -
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	Clean masonry	15	116855	SF	$ 5.13	$ 600,000
2.10	Repair masonry facing	75	2000	SF	$ 275	$ 550,000
2.15	Tuckpoint masonry joints	75	12000	LF	$ 8	$ 96,000
2.20	Repair transverse ties	75	1	LS	$ 35,000	$ 35,000
2.25	Crack injection	75	2500	LF	$ 45	$ 112,500
2.30	Crack sealing	75	1500	LF	$ 11	$ 16,500
2.35	Remove Graffiti	N.A	1	LS	$ 15,000	$ 15,000
2.40					$ -	$ -
2.45					$ -	$ -
2.50					$ -	$ -
						$ 1,425,000

3.00 RAILINGS

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

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	Repair plans	N.A	1	LS	$ 75,000	$ 75,000
5.10	Baseline survey	N.A	1	LS	$ 5,000	$ 5,000
5.15	Drainage pipe extensions	50	46	Each	$ 750	$ 34,500
5.20					$ -	$ -
5.25					$ -	$ -
5.30					$ -	$ -
5.35					$ -	$ -
						$ 114,500

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 27004 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.

MAINTENANCE COST SUMMARY

	ITEM	ANNUAL COSTS
1.00	SUPERSTRUCTURE	$ 13,900
2.00	SUBSTRUCTURE	$ 125,800
3.00	RAILINGS	$ 5,400
4.00	DECK	$ 7,800
5.00	OTHER	$ 13,000
		$ 165,900

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	Spot Paint Truss Span	10	6500	SF	$ 6	$ 39,000	$ 3,900
1.10	Repaint Truss Span	40	65000	SF	$ 6	$ 400,000	$ 10,000
1.15					$ -	$ -	$ -
1.20					$ -	$ -	$ -
1.25					$ -	$ -	$ -
1.30					$ -	$ -	$ -
1.35					$ -	$ -	$ -
1.40					$ -	$ -	$ -
1.45					$ -	$ -	$ -
1.50					$ -	$ -	$ -
						$ 439,000	$ 13,900

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	Clean masonry	15	116855	SF	$ 3	$ 370,000	$ 24,667
2.10	Tuckpoint masonry joints	10	15000	LF	$ 8.00	$ 120,000	$ 12,000
2.15	Repair masonry facing	10	2625	SF	$ 285.71	$ 750,000	$ 75,000
2.20	Scour repair	10	1	LS	$ 10,000.00	$ 10,000	$ 1,000
2.25	Crack injection	10	2500	LF	$ 46.00	$ 115,000	$ 11,500
2.30	Crack sealing	10	1500	LF	$ 11.00	$ 16,500	$ 1,650
2.35					$ -	$ -	$ -
2.40					$ -	$ -	$ -
2.45					$ -	$ -	$ -
2.50					$ -	$ -	$ -
						$ 1,381,500	$ 125,817

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 Railings	5	1	LS	$ 10,000	$ 10,000	$ 2,000
3.10	Repaint Railings	40	1	LS	$ 35,000	$ 35,000	$ 875
3.15	Flush railing with water	1	1	LS	$ 2,500	$ 2,500	$ 2,500
3.20					$ -	$ -	$ -
3.25					$ -	$ -	$ -
3.30					$ -	$ -	$ -
3.35					$ -	$ -	$ -
3.40					$ -	$ -	$ -
3.45					$ -	$ -	$ -
3.50					$ -	$ -	$ -
						$ 47,500	$ 5,375

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
4.05	Flush deck with water	1	1	LS	$ 1,500	$ 1,500	$ 1,500
4.10	Flush draingage system with water	1	1	LS	$ 1,500	$ 1,500	$ 1,500
4.15	Replace bituminous pavement	50	58800	SF	$ 3.83	$ 225,000	$ 4,500
4.20	Repair/replace expansion joints	25	112	LF	$ 71.43	$ 8,000	$ 320
4.25					$ -	$ -	$ -
4.30					$ -	$ -	$ -
4.35					$ -	$ -	$ -
4.40					$ -	$ -	$ -
4.45					$ -	$ -	$ -
4.50					$ -	$ -	$ -
						$ 236,000	$ 7,820

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	Underwater Inspection & Report	5	1	LS	$ 20,000	$ 20,000	$ 4,000
5.10	Fracture critical inspection and report	4	1	LS	$ 12,000	$ 12,000	$ 3,000
5.15	Arm's length Masonry Inspection & Report	10	1	LS	$ 15,000	$ 15,000	$ 1,500
5.20	Annual Inspection	1	1	LS	$ 4,000	$ 4,000	$ 4,000
5.25	Survey	10	1	LS	$ 5,000	$ 5,000	$ 500
5.30					$ -	$ -	$ -
5.35					$ -	$ -	$ -
						$ 56,000	$ 13,000

MINNESOTA HISTORIC PROPERTY RECORD

PART I. PROPERTY IDENTIFICATION AND GENERAL INFORMATION

Common Name: Stone Arch Bridge

Bridge Number: 27004

Identification Number: HE-MPC-0176

Location:

Feature Carried:	Pedestrian Trail
Feature Crossed:	Mississippi River
Descriptive Location:	St. Anthony Falls
Town, Range, Section:	29N-24W-23
Town or City:	Minneapolis
County:	Hennepin

UTM:

Zone:	15
Easting:	479599
Northing:	4980854

Quad:

Minneapolis
7.5 Minute Series
Not available

Present Owner:

State

Present Use:

Carries pedestrian and bicycle trail

Significance Statement:

The Stone Arch Bridge is a monumental symbol of the growth and expansion of James J. Hill's St. Paul, Minneapolis, and Manitoba Railway Company, which formed a significant portion of the Great Northern Railway and his railway empire in the Northwest. The bridge was a key element in his expansion to the Pacific, and it continues today to represent Hill's vision.

During the early 1870s, Hill was closely watching the Red River of the North that flowed north to Lake Winnipeg. Fort Garry (present-day Winnipeg) was a critical post for the Hudson Bay Company, which was trying to keep control over the Canadian fur trade but did not serve independent traders. Hill did service the individual traders, and in order to minimize this dangerous competition, Norman Kittson of the Hudson Bay Company decided to join with Hill to form the Red River Transportation Company.

Hill traveled up Red River in 1870 to investigate the cause of a French and Indian mob that had captured the Hudson's Bay Company post in Fort Garry. During that trip and others, Hill saw the

rich soil of the region and noticed the St. Paul & Pacific Railroad's steady decline. Grasshoppers were plaguing the farmers, and their presence made it difficult for locomotives to get traction on the rails. Hill thought that if he could buy the railroad line then he could make a profit from it by extending it to Fort Garry. The Panic of 1873 proved the final death blow for the St. Paul & Pacific, sending it into bankruptcy and receivership. Hill saw his chance to acquire the St. Paul & Pacific and other lines in similar crises.

But first Hill needed to secure more capital. He went to Norman Kittson. They each had a little money but needed much more, so they approached Donald Smith of the Hudson Bay Company and told him their plan for making the St. Paul & Pacific a profitable line. Smith offered money and talked with George Stephen, president of the Bank of Montreal. Stephen did not support the group at first in their efforts to acquire the line, but joined them three years later in their pursuit. The four, known as "the Associates," secured legislative changes, worked with bondholders, and worked for extended dates for construction of segments of rail line that were still required for completion. In March 1978, the Associates signed an agreement to purchase bonds controlled by Dutch investors. In total, they purchased the rail line, valued at $19 million, for only $5.4 million.

In May 1879, the St. Paul, Minneapolis, and Manitoba Railway Co. formed, with James J. Hill serving as general manager. Hill aggressively upgraded and expanded this railroad network, in part by bargaining for trackage rights with Northern Pacific Railway. Hill set his sights on crossing the continent, but before that could happen, he had to cross the Mississippi River.

Part of Hill's network included the Minneapolis Union Railroad (a belt line between St. Paul and St. Anthony). To provide access to a new railroad station in Minneapolis and to bring passenger traffic from St. Paul directly into the city's downtown business district, Hill and the City of Minneapolis formed a partnership to construct a bridge across the Mississippi River at St. Anthony Falls.

Hill originally wanted an iron bridge crossing the Mississippi above the Falls of St. Anthony at Nicollet Island. Bridge engineer Col. Charles C. Smith realized, however, that such a design would create a bottleneck on the river and could destabilize the eroding sandstone beneath the falls. The Falls had already been rendered unstable by the Eastman Tunnel disaster of 1869, and if a new bridge at this location further eroded the sandstone, the Falls could collapse causing a loss of its waterpower resources. Smith presented Hill with a bridge design that placed the east bank bridgehead below the Falls and the west bank bridgehead running parallel to the river in order to provide a straight entry into the Union Depot.

The 2100-foot bridge, designed by Colonel Smith, is composed of 23 Kasota limestone arches built on St. Cloud granite piers that rest on the St. Peter Sandstone bedrock. The spans vary in length from 40 to nearly 100 feet. The bridge's deck is located approximately 60 feet above the water. To meet the proposed Union Depot on the west riverbank, the bridge was designed with a 817-foot, six-degree curve at the west end. It carried double tracks with a deck width of approximately 24½ feet between the parapets.

In his article, "'Hill's Folly': The Building of the Stone Arch Bridge", Ray Lowry described the materials used in the structure:

The foundations for the bridge's piers were built of solid granite hauled in from Sauk Rapids, Minnesota. All exposed work on the upper portion of the bridge was built of magnesium limestone quarried at Mankato, Minnesota, and Stone City, Iowa. Marble used for the trimming on the deck of the structure came from Bridgeport, Wisconsin. Limestone, used for the unexposed portions of the bridge, was quarried on the site. In all, 100,000 tones of stone were needed for the project and the logistics of supplying such a huge amount of material was no

simple matter. From June 1882 until November 1883, not less than five marble-laden railroad cars were contracted to leave Bridgeport each and every day. During the same period, 2,000 carloads of Mankato limestone were used.

In order to bond such a huge amount of stone together, an equally large amount of mortar was required. In all, 30,554 cubic yards of various cements were used on the project. Because much of the masonry work was done during the winter, a method of preparing cement in subfreezing temperatures had to be devised. Col. Smith, the chief engineer of the project, came up with a simple solution to this problem. Eight quarts of salt were incorporated into each barrel of cement and then mixed with hot water. The salt content of the solution prevented the cement from freezing and, upon drying, the salt was simply absorbed into the pores of the stone.

The bridge was constructed between 1881 and 1883. Hill employed 600 workers who worked throughout the summer and winter (utilizing horse and steam power) to complete the bridge. The total cost was approximately $650,000.

Shortly after the bridge was constructed (between 1907 and 1910), the arches were reinforced. This included the installation of transverse steel rods between the spandrel walls, which were encased with concrete fill inside the spandrels. This was presumably done to counteract bulging of the spandrel walls due to poor drainage, but also served to allow heavier loads. In 1925 the railroad tracks were widened, and the parapet walls were cut back to accommodate the increased size of trains.

In 1962, two of the spans were replaced by a 196-foot Warren deck steel truss to allow river traffic to pass upstream to north Minneapolis, as part of the “Upper Harbor” project which also included two sets of locks and dams. The straight truss was set in the curved portion of the bridge, so its width was greater: 36 feet between the centerlines of the outer beams.

In April of 1965, a record flood of the Mississippi River undermined one of the piers and caused it and the two adjoining arches to sag about 14 inches. Repairs included reinforcement of the arch barrels in spans #6 & 7, and encasement of the footings on Piers #5, 6, & 7. Additional steel tie rods were installed to reinforce the spandrel walls, and many of the limestone blocks were refaced with concrete (scattered locations throughout the bridge).

In 1978, the last passenger train crossed the bridge and by 1982, the rail use had ceased. The line was officially abandoned in 1987. The Hennepin County Regional Railroad Authority purchased the bridge in 1989. Ownership was transferred to the Minnesota Department of Transportation in 1992. In 1993 the bridge was extensively remodeled for use as a pedestrian bridge (the bridge also carries tourist “trolley” busses). A.G. Lichtenstein & Associates provided the design, and the contract was awarded to Johnson Brothers Construction.

In 1994, the bridge was rehabilitated and opened to pedestrians, bicyclists and the River City Trolley. The deck features walking and bike lanes, metal safety rails, and ornamental light fixtures. An interpretative panel and view scopes were added in 1997.

Structural repairs conducted in 1993 to the stone arch spans included crack repair (using epoxy injection), and re-facing of numerous limestone blocks (with a 7” stone veneer). To prevent future bulging of the spandrel walls due to trapped water, all of the original spandrel fill (rock ballast) was removed. A waterproof membrane was placed on the interior spandrel surfaces, and a new drainage system was installed. The spandrel area was then re-filled with aggregate, and a bituminous roadway (flanked by concrete sidewalks) was placed on the bridge deck. The steel deck truss span was re-painted, and the truss bearings and expansion joints were replaced. Ornamental steel railings and light posts were installed along the entire length of the bridge.

The successful renovation and adaptive re-use of the Stone Arch Bridge has received numerous honors, including a 1995 award from the Minneapolis Heritage Preservation Commission and the Minneapolis Chapter of the American Institute of Architects, as well as a 1996 “Design for Transportation National Award” from the U.S. Department of Transportation. The Stone Arch Bridge now serves as a key link in the St. Anthony Falls Heritage Trail, connecting historic buildings and archaeological sites on both sides of the river.

The American Society for Civil Engineers listed the bridge in 1978 as a National Historic Engineering Landmark, stating that “it is acknowledged to be one of the finest stone viaducts in the world, due to its massive masonry, lofty arches, and graceful curvature.”

The Stone Arch Bridge is a contributing element to the St. Anthony Falls Historic District under Criterion A. Also, the bridge is eligible under Criterion C as a significant engineering example of a stone arch railroad bridge.

PART II. HISTORICAL INFORMATION

Date of Construction:

1883

Contractor and/or Designer (if known):

Contractor:

Designer: Col. Charles C. Smith

Historic Context:

National Register Criterion:

A, C

PART III. DESCRIPTIVE INFORMATION

Descriptive Information:

The 2100-foot bridge, designed by Colonel Smith, is composed of 23 Kasota limestone arches built on St. Cloud granite piers that rest on the St. Peter Sandstone bedrock. The spans vary in length from 40 to nearly 100 feet. The bridge's deck is located approximately 60 feet above the water. To meet the proposed Union Depot on the west riverbank, the bridge was designed with a 817-foot, six-degree curve at the west end. It carried double tracks with a deck width of approximately 24 ½ feet between the parapets.

PART IV. SOURCES OF INFORMATION

References:

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City of Minneapolis
2005 Minneapolis River Front Bridges Website. (www.mrdbridges.com/stoneArch.php)

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1987 Hill's Folly: The Building of the Stone Arch Bridge. Hennepin County History, Winter.

Luecke, J.C.
1997 The Great Northern in Minnesota: The Foundations of an Empire. Grenadier Publications, St. Paul, Minnesota.

Peterson, G.O.
2003 Historic Context: The St. Paul and Pacific Railroad Main Line. Prepared for the Minnesota Department of Transportation by URS/BRW. June 2003.

PART V. PROJECT INFORMATION

Historians:

Kristen Zschomler
Robert M. Frame

Form Preparer:

Mead & Hunt, 2006

MHPR NO. HE-MPC-0176

D. Historic context: Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945

NOTE: The original text of this context is included in "Reinforced-Concrete Highway Bridges in Minnesota," National Register of Historic Places, Multiple Property Documentation Form, prepared by Robert M. Frame III, Ph.D., 1988, available in the Minnesota State Historic Preservation Office.

Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945

MATERIALS: An Introduction to the Elements of Concrete

Reinforced concrete universally consists of three elements: binder, filler, and reinforcement. The binder material in concrete is cement, and it is important to remember that concrete and cement are not synonymous. There is no such thing as a cement sidewalk, a cement block, or a cement bridge. There are concrete sidewalks, concrete blocks, and concrete bridges. Cement is a fine gray powder made of calcium, silica, and other minerals.

Cements (and the resulting concrete) are either hydraulic or non-hydraulic, meaning that they either do or do not harden under water and remain durable when wet. All modern cements and concretes are hydraulic.

Hydraulic cement either is produced from naturally occurring cement rock and is termed "natural cement," or it is manufactured from lime and other ingredients and is called "portland cement." Portland cement was first produced and patented in England in 1824. Although it was used in the United States, it was not manufactured here until a Pennsylvania plant was opened in 1871. Minnesota was one of a dozen or more states producing natural cement around 1902-04, but not portland cement.[1]

While the quality of natural cement is determined largely by the rock from which it is made, portland cement is a scientifically controlled product. This control would become increasingly important as the use of concrete escalated rapidly in the early twentieth century and engineers focused on the quality of the ingredients. Cement is the key ingredient in concrete. As demand increased, quantity output naturally became important. Introduced in the 1890s, the rotary cement-kiln provided continuous processing. The mass availability of carefully proportioned portland cement provided the basis for a construction industry utilizing concrete. The natural cement industry was finished. As an engineer remarked in 1894, "the use of Portland cement concrete has wrought a revolution in all branches of civil engineering, and it seems that we are only in the beginning of the radical changes, which in bridge work, sewers, water works, railroads, etc., are following its introduction."[2]

Since cement is only a bonding agent, it is mixed with filler to give it "monolithic bulk," or enough substance to be formed into a unified whole that can stand alone. The filler consists of "aggregate." Generally aggregates are naturally occurring sands (fine aggregate) and gravels (coarse aggregate). (When cement is mixed only with fine aggregate, the resulting compound is termed "mortar.") As with the cement, the origin, size, and nature of the aggregate became more important as engineers and scientists learned more about concrete construction. Simply mixing cement with gravel from a nearby pit was not necessarily desirable for quality concrete.

Finally, to create concrete, water must be added to the cement and the aggregate. The quantity and quality of the water, and the proportioning of all the ingredients, is extremely important and subject to

analysis. Specifications for bridge contractors working in concrete will indicate the required ingredients and their proportions.

The nature of the concrete used in concrete bridges affects the quality and economy of the structure. Other factors (outside of bridge design) involved in quality and economy include elements such as formwork, and mixing and placing the concrete. The larger the structure, the more these become critical. In particularly large projects, such as the Mendota-Fort Snelling continuous-arch bridge (Mn/DOT Bridge 4190), the design and engineering of the contractor's work is a gargantuan task that has a major impact on the project's cost. Formwork- "centering" in these large arch bridges- is an engineering specialty all its own.[3]

ENGINEERING AND DESIGN: Basic Elements and Bridge Types

Reinforcement

The first concrete bridge in the "modern" world (concrete construction was known in ancient Rome) was built in France in 1840; the first in the United States was built in 1871 in Prospect Park, Brooklyn.[4] These were arch bridges without reinforcement; concrete bridge design and construction does not demand reinforcement, since a massive enough concrete structure will absorb any tensile stresses.[5] A major unreinforced or "plain" concrete bridge, the Rocky River Bridge in Cleveland, Ohio was built as late as 1910. With its 280-foot span, this giant was the last of its type.[6] There are no extant concrete bridges in Minnesota that are known be of "plain concrete" (not reinforced).

The monolithic bulk comprised of cement and aggregate (binder and filler) is strong in compression but weak in its resistance to tensile stresses. To overcome the lack of tensile resistance, reinforcement is added in areas that will be subjected to tensile forces. The history of reinforced concrete should be understood in terms of the evolution of reinforcing, as well as in its own right as a building material.[7]

The materials of reinforcement, historically, have been related to systems of reinforcement: i.e., the Melan system used a curved I-beam, the Kahn system used the Kahn Bar, and so forth. Basically the materials have been steel rods or bars, while a variety of forms and shapes have been employed. Systems regarded as being early and significant include: Josef Melan reinforcing system, Fritz von Emperger reinforcing system, W. C. Marmly reinforcing system, Daniel Luten patents, James B. Marsh rainbow-arch patent, George M. Cheney patent (used by Standard Reinforced Concrete Co.), Kahn reinforcing bar (used by Trussed Concrete-steel Co.), Cummings reinforcing bar, and the Thacher reinforcing bar.[8] Even the term "reinforced concrete" was not standardized until the turn of the century.[9] The first national standards on reinforcing came in 1911 when the Committee on Steel, of the American Society for Testing Materials (ASTM) adopted specifications for reinforcing steel, covering plain, deformed, and cold twisted bars. Prior to this, any standards came from individual industry and municipal sources.[10]

The Reinforced-Concrete Arch Bridge

The masonry-arch bridge has been built since ancient times and its basic features have long been well known. The basic arch form was adapted to both plain- and reinforced-concrete construction. Since the mid-nineteenth century, builders had experimented with reinforcing in concrete and in 1889 the first reinforced-concrete bridge was built in the United States. It was the Alvord Lake Bridge in Golden Gate Park, San Francisco, and was the work of English-born Ernest L. Ransome, who had worked with concrete in California since the 1860s and with reinforcing systems since the 1880s. In 1884, he

patented a twisted reinforcing bar. During the same period, arch experimentation was continuing using the metal mesh system of Josef Monier.[11]

Most influential of all, however, was Viennese engineer Josef Melan, who in 1894 received an American patent on his reinforcing system. It consisted "of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose." Interestingly, in terms of geography, the first American bridge to embody the Melan system reportedly was a small highway span designed by German-born engineer Fritz von Emperger and built by William S. Hewett at Rock Rapids, Iowa, the same year as the patent.[12] Several small but early Melan bridges were built and designed by Hewett in Minneapolis and Saint Paul for the Twin Cities Rapid Transit and survive today as park structures (Mn/DOT Bridge L-9329, Bridge L-5853, Bridge 92247).

--Open Spandrel and Filled Spandrel Designs

The space between the bridge arch and the bridge floor, known as the spandrel area, can be treated in a number of ways. In a smaller bridge, the floor is partly supported by longitudinal walls termed spandrel walls, which rise from the arch to the deck. The hollow interior space is filled with earth or other material, and the bridge is termed a "filled-spandrel" arch. This design involves a heavy dead load on the arch, which is too great in larger structures. To reduce the weight, the spandrel area is opened up. The walls and fill are replaced by columns or transverse walls that rise from the arch to carry the floor. This is an "open-spandrel" arch. These columns and walls are found in a variety of combinations and arrangements, depending on the size of the bridge. Barrel arch designs may be either filled- or open-spandrel; rib-arch designs are usually--but not always--open-spandrel. Minnesota has at least one example of a rib-arch-with a spandrel curtain-wall (Mn/DOT Bridge 5772), and this type has been built elsewhere.[13] The spandrel wall provides an opportunity for architectural treatment. Minnesota has many examples of both basic spandrel configurations, filled and open.

--Barrel Arch and Rib Arch Designs

In 1897 von Emperger, who built many Melan bridges, received two patents for additions to the Melan system. These incorporated additional steel which led, according to engineering historian Carl Condit, toward rib-arch design: "The division of the continuous arch barrel into separate ribs was achieved in the U.S. by F. W. Patterson, an engineer with the Department of Public Roads in Allegheny County, Pennsylvania. Patterson began in 1898 to design small highway spans in which the deck was supported by two parallel ribs each reinforced with a single curved I-beam."[14] In arch-bridge construction, the arch ring may be constructed either as a single arched structural element (a barrel) or in separate but parallel longitudinal elements (ribs). Ribs usually are interconnected by cross struts and braces. Historically there is a rough evolution from an early reliance on the barrel design to a widespread acceptance of the rib design. In terms of size, the larger the bridge the more likely that it is a rib design, since the rib configuration allows less material to be used, thus reducing cost, and lightens the weight of the bridge superstructure. On the other hand, a rib design involves more complicated formwork, thus adding an expense to an already expensive component. Minnesota has examples of each type.

In some cases it is difficult to say if a particular bridge is composed of ribs or double barrels, and it usually amounts to a distinction without a difference. A variation on this theme is found in the above-noted Rocky

River Bridge, which employs "Luxembourg construction," named after the Luxembourg Bridge (1903) over the Petrusse River in Germany, wherein "two comparatively narrow bridges are built side by side; the space between is then bridged over by a roadway."[15]

--Early Twentieth-Century Experimentation in Arch Design

Carl Condit views the turn-of-the-century period as one of experimentation and novelty in design, with the Melan system of reinforcing in the ascendant for concrete arches, although the more efficient methods of bar reinforcing, introduced by Ransome in 1889, were beginning to gain new attention. For a decade after 1900, the design of arch bridges tended to be conservative. The problem with Melan was that it required too much steel, making in actuality a steel bridge encased in concrete. A major Minnesota bridge of Melan construction, the Third Avenue Bridge (Mn/DOT Bridge 2440) in Minneapolis, was built at the end of the Melan era in 1914-16.

By 1910, according to Condit, the main line of evolution was moving away from massive construction, "with its echoes of the masonry tradition, toward the flattened parabolic curves of narrow ribs, the slender spandrel posts, and the minimal piers that scientific reinforcing was to make possible."[16] Among the systems that diverged from Melan was that patented in 1903 by Julius Kahn, which introduced the innovative Kahn Bar, actually a flat bar with the outside edges cut and bent upward to form shear reinforcement. In a 1903 article, Kahn argued that "concrete should be reinforced [sic] in a vertical plane, as well as a horizontal one," and further argued that his bar did this:

> "All of these results have been accomplished by taking a bar of cross section... and shearing the web upwards into an inclined position on both sides of the main body bar, thereby forming substantially the tension members of the ordinary Pratt truss."[17]

Another prominent early advocate for reinforced concrete was the Indiana engineer Daniel B. Luten,[18] who began to publish the first of many articles about this time and was responsible for another alternative to Melan:

> A more scientific solution [than the Melan system], closer to Ransome's method and pointing to later techniques of bar reinforcing, was the introduction from Germany about 1900 of the Luten system for reinforcing wide-span culverts. In this system several bars forming a complete loop were laid transversely through the vault and the bed, or invert, of the culvert, and a series of such loops were laid at regular intervals throughout the length of the structure. The bars were bent to conform to the semicircular section of the vault and the shallow curve of the trough-like invert and to lie near the surfaces of maximum tension under live load. In spite of such early uses of the concrete arch for railroad bridges of great size, the form has never been popular for rail service chiefly because of the problem of absorbing high impact loads.[19]

As with reinforcing bars and systems, not all of the arch forms proved to be prototypical, or even particularly influential. For example, the patented Marsh rainbow-arch design was built at several locations throughout Minnesota in the pre-World War I era, producing significant and visually striking structures, while never entering the design mainstream. Nevertheless, a monumental and significant example was built in 1926, St. Paul's Robert Street Bridge (Mn/DOT Bridge 9036)

In passing, it can be noted that arch bridges divide into two large categories, single arch or continuous arch. A continuous-arch bridge is so designed that, at any pier, the presence of one arch is necessary to provide the abutment-like countervailing force for the adjoining arch. If two single (non-continuous) arches are adjacent at one pier, the pier construction itself will provide the necessary abutment force even if one arch is removed. In practice, almost all multiple-span arches are continuous, and Minnesota has many examples.

--Standardization of Reinforced-Concrete Bridge Construction

In Carl Condit's analysis, the period from World War I to the Depression was largely one of refinement and standardization in reinforced-concrete-arch construction. It was marked by two important regional bridge-building programs: one in Minnesota's Twin Cities metropolitan area after 1915, and another in the California Department of Highways system after 1920. These groups epitomized fine design rather than the innovative and experimental work that characterized the earlier, prewar era. Each offered increasingly larger and longer--and longer-span--crossings, as well as more sophisticated versions of reinforced-concrete design. Prominent examples include Minneapolis's Cappelen Memorial Bridge (Mn/DOT Bridge 2441, 1919-23) and the Mendota-Fort Snelling Bridge (Mn/DOT Bridge 4190, 1925-26), both of which set world length records when built, and California's exquisitely proportioned Bixby Creek Bridge (1931-33). The Minnesota group is discussed in greater detail below.

The high point of standard fixed-arch design (i.e., an arch without hinges and therefore "fixed," stable, and rigid[20], a form used almost universally for concrete bridges with span lengths above 100 ft.) came in 1930-31 with the Westinghouse Memorial Bridge over Turtle Creek Valley in Pittsburgh. Its center span of 460 feet was the longest for a concrete arch in the United States.[21]

Much of what followed the Westinghouse Bridge, in reinforced-concrete bridge work, was a move away from increasingly costly arches toward precast and prestressed girders, deck slabs, and bents. The great demand for highway bridges "eventually became so great that they had to be erected by methods equivalent to mass production."[22] Thus, even though a major engineering research study of reinforced-concrete arches was conducted at the University of Illinois in the early years of the Depression, [23] the demands of economics eventually forced bridge design and construction in other directions. By World War II, the great era of reinforced-concrete arch construction had come to an end, superseded in the reinforced-concrete-bridge world by girders, rigid frames, and precast and prestressed construction.[24]

Reinforced-Concrete Slab, Beam, and Girder Bridges

The reinforced-concrete bridge may be best known in its arch form, since that has been the type employed for the largest, most spectacular, and ornate structures. Far more common, however, have been simple slab, beam, and girder bridges. Following their quick adoption and standardization by the state highway commissions that were created in the decade after 1900, these bridge forms were recommended everywhere for small to medium spans. By the 1920s arch bridges were recommended only for locations with very sound foundations for the abutments.[25] As late as 1906, however, arch-designer Daniel B. Luten wrote that a reinforced-concrete girder bridge ordinarily was not as economical as an arch, unless the abutments were already in place. Luten's example is a situation where a metal truss or beam span had been removed and, of course, an arch would be almost impossible to build, since the abutments had been designed for compression and not for arch thrust.[26]

For the highway department planner, slab, beam, and girder bridges would differ only in construction cost, according to the noted Oregon bridge engineer Conde B. McCullough, who published a study of the economics of highway bridge types in 1929.[27] Each may be used for a variety of span lengths, but only certain types are economical for certain lengths. For example, a slab bridge theoretically could be constructed to almost any span length desired. To achieve a long span with any load-carrying capacity, however, the slab would have to be unreasonably thick and be built with an uneconomically large amount of materials, compared to another design such as a girder. A secondary consideration is the amount of vertical clearance available with each type.

If the design of the concrete arch grew out of the masonry arch, slab and girder bridges were directly related to developments in concrete-building construction. The first concrete girder used in bridge work came in 1898 in Pittsburgh, Pennsylvania, and was similar to the Melan arch reinforcement. An I-beam was encased in concrete to form a reinforced-concrete girder and these were used as main girders and as stringers. As with the Melan work, the I-beam proved to be less desirable than bar reinforcing, and this method emerged around 1905 and was changed very little thereafter. In fact, according to Condit, "the number of concrete girder bridges is so great and the design and appearance so nearly uniform that it is difficult to select examples that are more noteworthy than many others."[28]

Reinforced-Concrete Slab Spans

In its most basic form, the slab-span bridge is nothing more than a square or rectangular panel of reinforced concrete with each end resting on an abutment or other vertical support, and with a railing mounted along each side of the slab. This simplicity has the asset of requiring uncomplicated and economical formwork and less labor in placing the reinforcing; it has the liability of requiring more concrete and steel than girder spans. Also, the simple slab can be used in locations requiring a minimum of vertical clearance or headroom. Overall, simple slab bridges are economical for only the shortest spans, since longer slabs require too much concrete and reinforcing material compared to a beam or girder of equivalent length, thus increasing the cost of the slab relative to the girder. In 1916 Taylor and Thompson recommended limiting slab length to only 10 to 12 feet for heavy loading (trolleys and trucks) and up to 20 feet for less severe loadings.[29] In 1920 Milo Ketchum stated that slabs could be employed for spans up to 25 feet, but were not economical for spans over 20 feet. Later engineering texts extended the maximum economical length to 30 feet.[30]

Like the girder and arch, slabs may be employed in a series of simple spans or the slab may be designed as a continuous span, where it is extended across a support of some kind. In 1921 Waddell found little difference, economically, between continuous and noncontinuous slabs, although he preferred the continuous from the point of view of paving and drainage. In 1939, however, Taylor, Thompson, and Smulski reported that the continuous design was cheaper, as well as being more rigid. Comparing the continuous slab with the continuous girder, the 1939 text reported advantages and disadvantages that are very similar for those in the simple-span comparison noted above. The continuous slab was simpler in terms of labor for formwork, arrangement of reinforcement, and placing of concrete; it had fewer critical sections in design; it had smaller areas of exposed concrete surface and thus lower surface-finish cost. Its disadvantages were greater cost of materials and larger dead loads. Except in cases where the lower headroom is needed, the added cost outweighed the advantages.[31]

Much of the discussion about continuous slabs involves the type of support, and one of the most significant innovations in slab design was C. A. P. Turner's adaptation of his flat-slab mushroom-column construction to bridge design. The first span to use this was his 1909 Lafayette Avenue Bridge over the Soo Line tracks in St. Paul. It was built only a few years after Turner had applied for his original patents (1905) and had built his first flat-slab building in Minneapolis (1906), and in the same year that he published his own engineering text, *Concrete Steel Construction*.[32] The bridge has been demolished, as has a second known early example, the Mississippi River Boulevard Bridge (Mn/DOT Bridge 92250), which was designed by Turner for the St. Paul Park Board and constructed in 1909. It was replaced in 1987.[33] A single, known surviving example of Turner's reinforced-concrete work is the approach to the Mississippi River bridge at Wabasha (Mn/DOT Bridge 4588), designed by Turner and constructed by the Minneapolis Bridge Company in 1931.

By 1939 the column-supported, flat-slab design was being actively promoted by Taylor, Thompson, and Smulski, who commented that "in bridge construction... flat-slab floors have not been used to as great an extent as their merits would justify." They found this design to be very economical: "Often, by using a properly designed flat-slab construction, the cost of the bridge may be reduced by as much as 25 to 30 per cent of the concrete structure."[34]

In addition to Turner's and others' mushroom-column support (in which the slab is rigidly connected with the column), slabs can carried trestle-like, on concrete piles, concrete piers, or framed concrete bents. The trestle arrangement often is found in discussions of flat-slab designs for railroad bridges.[35]

A variation on slab design is the "T-beam," which is formed "where a concrete floor slab is constructed integrally with the supporting beams so that unity of action is insured."[36] A concrete deck-girder similarly integrated with a slab is much the same thing.[37] As discussed by Ketchum, a T-beam slab bridge can be seen as a transitional structure between a simple slab and a deck girder. Taylor and Thompson in 1916 stated that "when the combination of span and loading is such as to call for a slab thickness of more than 16 to 18 inches the simple slab will not prove as economical as the T-beam or girder type."[38] Generally, the T-Beam has been recommended for spans at the longer end of the slab range (20-35 feet). It uses less material than a simple slab, and it possesses some of the deck girder's disadvantages, i.e. it requires more headroom because of the beam.[39]

In 1916 the Minnesota Highway Commission reported developing a new reinforced-concrete slab design for 23-foot spans called the "cellular slab." Half-round sections of corrugated-pipe were used as forms on the underside of the slab, creating a pattern of hollowed-out "cells" in the finished concrete. The remaining concrete then functioned as longitudinal reinforced T-beams with cross beams. The intent was to reduce by one-third the amount of required concrete. Although construction of an experimental half-size model was reported, no further accounts of the use of this design have been found, nor has any example yet been located.[40]

Reinforced-Concrete Girder Bridges

As Taylor and Thompson stated in 1916, girder construction "becomes practical at the point where the simple slab ceases to be economical, while its maximum economical span is determined not only by the kind of loading provided for but also by the spacing and arrangement of the girders." The girder bridge,

they pointed out, "is in reality a modification of the slab bridge whereby a comparatively thin slab spans between a series of relatively deep beams which in turn span from abutment to abutment.[41]

--Single Span and Continuous-Girder Span

Girders are of two main types, single or continuous. The continuous girder bridge, with the girder extending over multiple spans, first appeared about 1910.[42] According to J. A. L. Waddell in 1921, there was not a great deal of economic difference between the two in highway bridges, and the continuous girder often was used, since it gave a solid, monolithic structure. In a multiple-span bridge with any danger of settling, however, a series of simple spans would be preferable. At the time, the balanced-cantilever type of girder was beginning to be used, involving for each unit a pier and two half-spans.[43] It is clear from discussions of girder bridges in Condit that the profile of girders can be misleading, since they are not always simply long rectangles, but may have various curves in their profiles. A girder can be given a slight concave curve along its lower edge for an aesthetically pleasing appearance. Hool and Kinne stated that "it is possible to construct a [cantilever girder] bridge resembling a concrete arch structure in appearance, in locations where the foundation conditions would not permit the construction of an arch...."[44] Without a more complete survey in Minnesota, it is difficult to be certain how many of each type survive, since single and continuous are not always properly designated in the Minnesota Department of Transportation inventory.

--Deck Girder and Through Girder

The fundamental difference between a deck-girder bridge and a through-girder bridge is straightforward: in a deck-girder, the bridge floor slab rests on top of the girders; in a through-girder, the bridge floor is a slab carried between the girders, which act as railings.

Each type has its advantages and its liabilities, and assessments of each remained consistent over two decades from 1920 to 1939.[45] The deck girder's liability is the depth required for its floor construction; the through girder carries the floor between the girders and therefore is preferred where headroom is limited. The situation is reversed when roadway width is a factor. Since the through girder is necessarily limited to the two girders containing the floor, its maximum roadway width is restricted to this outside-supported floor slab, or about 18 to 20 feet. On the other hand, a deck-girder configuration allows for multiple girders beneath the floor, thus extending the width potential. If necessary, the floor slab can be cantilevered beyond the outermost girders to provide additional width for sidewalks. By 1939, through girders were seldom used for highway bridges, although they continued in use for railroad bridges, which were not subjected to ever increasing width demands. Through girders were not being recommended for any road which might require future widening, a necessity by World War II that had not been anticipated twenty years earlier.[46]

Rigid Frame Spans

If a solid, horizontal slab is rigidly connected with vertical walls, a simple rigid-frame bridge has been created. The critical point is that the three sides are rigidly connected at the two "knees" or corners, and all work together in carrying a load. In sectional elevation, the rigid frame appears somewhat different from an abutment-supported slab. In the conventional slab arrangement, its abutments are heaviest at the bottom and lighter at the top where the bridge seat is located. In the rigid frame, the reverse tends to be true: the transverse vertical walls, which replace traditional abutments, are wedge-shaped, tapering downward to the footing. Overall, the rigid-frame bridge is considered much more economical than either

the T-beam slab or the fixed arch, particularly when unyielding foundations are easily obtainable. In addition, the rigid frame employs a smaller depth of construction, a decided advantage where headroom is limited and the required elevation of the top of the bridge is fixed. This is why rigid-frame bridges often have been used in grade separations, such as in freeway construction.[47]

Based on European precedents, the rigid frame was developed in the United States in the early 1920s by Arthur G. Hayden for parkway construction in Westchester County, New York. According to Condit, the rigid frame was the most important innovation in concrete bridge design after Turner's mushroom slab, and it "ranks second only to prestressing as a money-saving method."[48] In his 1931 text, Hayden stated that the concrete T-beam slab was probably more economical than the rigid frame for spans below 30 feet, but the concrete rigid-frame bridge was more economical from 35 to 80 feet. When built in steel, the rigid frame extended the economic advantage from 80 to 120 feet.

Hayden pointed out some variations of the rigid frame, which gave it a deceptive appearance. At times, the curve of the floor slab (it always has a slight arch in rigid-frame design) was great enough to make it appear to be a low-rise arch bridge. Also, the rigid frame sometimes has been constructed with large ribs instead of a solid barrel or slab, giving a visual suggestion of a low-rise ribbed arch. Some have an elliptical intrados.[49] In a narrow design, two rigid-frame ribs may have been used, one on each side of the bridge. The ribs may be extended above the road, creating a through version. As with other concrete spans, rigid frames could be used in a continuous design, sometimes termed "multi-span rigid frames."[50] It is possible that the true nature of a rigid-frame bridge may not be known until the bridge plans are reviewed and the bridge structure may be studied without its additional decorative pilasters and walls.

Within 15 years of its introduction, the rigid-frame bridge had gained wide popularity, replacing arches, slabs, and girders in many applications. In a 1938 address to the Concrete Reinforcing Steel Institute, "What the Future Holds for Reinforced Concrete," the president of the Portland Cement Association reported: "At the present time the rigid frame bridge is being actively promoted and practically every state in the Union has now accepted this type of construction as standard where it fits the location economically."[51]

REINFORCED-CONCRETE BRIDGES IN MINNESOTA

Before the Minnesota Highway Commission

There is very little documentation of reinforced-concrete bridge construction in Minnesota for the years prior to state involvement (i.e., basically before 1905). Almost all the evidence exists in the few surviving structures themselves. Fortunately, however, these extant bridges are excellent examples of significant early designs in both urban and rural areas.

In this pre-automobile era of "streetcar suburbs," where the former nineteenth-century "walking city" was being expanded dramatically by rails,[52] it is appropriate that the new reinforced-concrete bridge technology should be employed by the transit companies who were involved in other new technologies, such as electrification. Bridge builder, and concrete designer and promoter, William S. Hewett designed and built the bridges required by the Twin City Rapid Transit company around 1903-05. Surviving from this group are at least three small arch-bridges by Hewett that employ the Melan system of steel I-beam reinforcement to carry road over the rails: the Interlachen Bridge (Mn/DOT Bridge L-9329) in Minneapolis, and two Como Park bridges in St. Paul (MN/DOT Bridge 92247 and Bridge L-5853).[53]

While Hewett was busy erecting Melan-system streetcar bridges to link the twin metropolises of St. Paul and Minneapolis, an obscure mason and general contractor was designing and building small but elegant reinforced-concrete bridges in Rock County, an area so distant from the Twin Cities that it remains remote today. Perley N. Gillham, who built local roads and county buildings from the late nineteenth century to well into the twentieth, is an utterly unknown figure. He has left many small reinforced-concrete arch spans (some dated) on gravel roads, but virtually nothing is known of his background and where he learned his trade. Most of the bridges were built in the early and mid-teens and use a confusion of rod and twisted-bar reinforcement. One clue to the origins of Gillham's technique is the fact that just over the nearby state line in Iowa was the first Melan reinforced-arch in the United States, built by William S. Hewett for Fritz von Emperger at Rock Rapids in 1894. A photograph of the bridge shows a structure not unlike Gillham's in general size and scale. Ten years earlier, in 1883-84, Gillham and Hewett had worked at the same bridge project in Minnesota. Gillham repaired Rock County's Ash Creek Bridge in 1883 and Hewett built the replacement bridge in 1884. It is possible that the two established a relationship that later led to an exchange of information about reinforced-concrete construction techniques.[54]

Significance of the Minnesota Highway Commission

Through the creation of the Minnesota Highway Commission in 1905, the state government began a process of direct intervention in the bridge building process that continues today in enormous proportions that could hardly have been imagined at the outset. The initial era of the MHC was from 1905 to 1921, when the Babcock Trunk Highway Plan was adopted. During this first decade and a half, the state attempted to gain control over a road and bridge construction process whose antiquated, private-sector management was unable to deal adequately with, initially, the Good Roads Movement, directly followed by the introduction of the automobile. The new road systems demanded by vehicular transportation required two things that only the state could begin to provide: large amounts of money, and professional engineering and design.[55]

Bridges existing at the time of the commission's formation were not necessarily up to the loadings of modern vehicles, mainly heavy steam traction-engines. Early commission reports contain stories and photographs vividly demonstrating the bridge failures caused by these new machines. The problem was wooden and lightweight metal-truss bridges built on competitive design and bid by fabricators who sold cheap structures to nonprofessionals on township and county boards. In its first years, the MHC worked to stamp out these kinds of bridges by forbidding wooden bridges, and by appealing and (when possible) insisting that local designs by approved by state engineers. The movement toward concrete construction began in 1908 with state-prepared plans for concrete culverts and bridge floors. A few years later the MHC was recommending "lasting structures," meaning steel beam, Warren truss, and reinforced-concrete bridges. In 1912 specifications and standard plans were issued for steel and concrete bridges and included "reinforced concrete slab and girder bridges."[56] In his 1912 address on "Reinforced Concrete Highway Bridges," given before the Minnesota Society of Engineers and Surveyors, George Herrold of the St. Paul Department of Public Works recommended highway-bridge types and span lengths in accord with national consensus: the slab for spans 8 to 20 feet, the T-beam slab for spans 20 to 30 feet, and a girder design for spans 30 to 60 feet. In light of the new slab and girder designs, the arch was considered often uneconomical for a highway situation, but "a very desirable type"[57] for parks and approaches to towns and cities, where cost is not the first consideration.

Virtually all the major advances in basic reinforced-concrete bridge design were made in the first two decades of the twentieth century. By World War I, the fundamental designs of the "modern" reinforced-concrete arch, slab, and girder had been established. Only the rigid frame remained to be introduced in the 1920s. It was a time of creativity and experimentation for engineers and the new state highway commissions. The Minnesota Highway Commission participated by designing in 1916 a cellular-slab bridge (described above) in an attempt to refine existing slab design by reducing the amount of required concrete.[58] At the same time, the MHC decided to promote the construction of concrete-pile trestle bridges, after reviewing their use in railroad work.[59]

Other than the cellular slab, whose actual construction and use remains to be documented, there is nothing especially novel to report about the MHC and pre-World War I concrete-bridge construction. The essential concern of the state was that concrete (or steel) be used whenever possible, and that designs be professionally prepared and construction be professionally supervised, whenever possible. Exactly which concrete-bridge type was recommended would depend more on national professional standards than state-based opinions. The professional engineering literature clearly delineated the designs indicated for any particular situation. By 1930 the state was reporting that "our bridges are now being designed in substantial accordance with the approved specifications of the American Association of State Highway Officials (AASHO) which safely provides for the legal loadings specified in our own state laws. There appears to be a general tendency throughout the country to pass legislation safeguarding bridges built during recent years in accordance with recognized standard loadings."[60]

After World War I, the state's attention turned to the development of the trunk highway system initiated by the Babcock plan. Many bridges that the state "inherited" at that time were not up to new loadings, widths, or alignments and major efforts were made to upgrade or replace them. Particular concerns with concrete shifted to matters like aesthetics, or "what might be called the artistic features of bridge construction." This involved a reconsideration of railings, moving from the typical pre-war paneled slabs to a more open design. Other general areas of interest in concrete-bridge work were such things like clearances, floor construction, refining construction techniques, and developing better concrete ingredients. In a 1930 discussion of trunk highway bridges, the state's chief bridge engineer, M. J. Hoffmann, chose to emphasize major new structures over the Mississippi, the Minnesota, and the Red River of the North, rather the multitude of anonymous lesser bridges that routinely fulfilled AASHO standards in whatever form necessary.[61]

"King Concrete" and the Great Arch Bridges

If the first decades of reinforced-concrete bridge work had been a time of experimentation, the dramatic focus of years between the wars was on the spectacular monumental structures that extended the size and range of the earlier designs. Reinforced-concrete bridges of heroic proportions were designed and built, dominating the landscape. It was the era of "King Concrete," as characterized by Canadian bridge historian David Cuming.[62]

In its reports, the Minnesota Highway Commission showcased its large concrete arches at Brainerd, Redwood Falls, Fond du Lac, and two at Anoka.[63] The most exciting work, however, was in and around the Twin Cities, where urban expansion and the automobile encountered the great bluffs and gorges of the Mississippi and Minnesota rivers. "Nature has perhaps nowhere provided a more beautiful setting for an arch bridge than in the Mississippi River valley between Fort Snelling and St. Anthony," declared St.

Paul City Engineer George M. Shepard, in 1927.[64] To meet these challenges engineers designed world-record concrete-arch spans.

The Third Avenue Bridge (MN/DOT 112440, 1914-16) above St. Anthony Falls in Minneapolis constitutes a preamble to this work, being the last major use of Melan-rib reinforced-concrete construction in the Twin Cities. Following Third Avenue was a series of open-spandrel, reinforced-concrete bridges recognized by bridge historian David Plowden as "the first really sophisticated American program of concrete highway bridge construction" and considered highly significant by Carl Condit. Included are the Cappelen Memorial (Franklin Avenue) Bridge (Mn/DOT Bridge 2441, 1919-23), the Inter-City (Ford Parkway) Bridge (Mn/DOT Bridge 3575, 1925-27), the Robert Street Bridge (Mn/DOT Bridge 9036 monumental rainbow arch, 1924-26), and the Tenth Avenue (Cedar Avenue) Bridge (Mn/DOT Bridge 2796, 1929). In addition, Hennepin County built the Fort Snelling-Mendota Bridge (Mn/DOT Bridge 4190, Minnesota River, 1925-2b) over the Minnesota River at its confluence with the Mississippi. Most significant of the group were the Cappelen Memorial Bridge, whose 400-foot main span was the longest concrete arch in the world when built, and the Mendota Bridge, at 4,119 feet, the longest continuous-concrete-arch bridge in the world when built. These bridges constitute masterworks by nationally significant Minnesota engineers, including C. A. P. Turner, Walter Hall Wheeler, Frederick William Cappelen, Kristoffer Olsen Oustad, and the firm of Toltz King & Day. This group includes members of Minnesota assembly of Norwegian-American engineers of exceptional quality, whose reputation and fame was earned in Twin Cities reinforced-concrete bridge design: Frederick William Cappelen, Kristoffer Olsen Oustad, Andreas W. Munster, Martin Sigvart Grytbak, and Olaf Hoff.[65]

Reinforced-Concrete Park Bridges

Along with the chronological coincidence of urban expansion, the growth of city and state road systems, and the introduction of reinforced concrete, came the rise of the urban park. As social historian Alan Tractenberg has observed, noting particularly the ideas of park architect Frederick Law Olmsted, the park was meant to be a refuge from, and thus a contrast with, both the commercial and industrial center and the immigrant-crowded neighborhoods of worker housing. With its curvilinear streets, green open space, all carefully landscaped, the urban park was "all pastoral picture, composed views, nature artfully framed as spectacle."[66]

Within the park, the bridge was not merely an expected necessity, but it emerged as an opportunity. Here the city park commission and landscape architect could request special bridge designs, in harmony with the grand park scheme. Bridge engineer and aesthetic critic Henry Grattan Tyrrell declared in 1901: "In the matter of ornamental park-bridges the engineer has opportunity to display more or less artistic taste, and create not only useful works, but architectural ornaments as well." He indicated also that:

> It can not ...be expected to put up ornamental structures in any of the rural districts, or to any great extent for the use of railroads. The opportunity in the line of ornamental bridge-construction lies chiefly in and around our large cities and park systems and it is greatly to be hoped that, as old wooden bridges decay and are removed, our progressive American people will see their opportunity to replace these with suitable ones of iron and stone, made not simply to carry loads, but to be prominent architectural ornaments.[67]

For Tyrrell, particularly appropriate park styles would be based on the arch or suspension bridge, with rustic treatment desirable.[68] The park further provided an ideal opportunity to explore the possibilities of the new concrete and a great variety of forms emerged (with notable early examples illustrated in the works of Tyrrell and others[69]).

Today, since parks seldom have undergone the heavy usage and expansions of all other road systems, many of the original park bridges survive. Parks now provide us with significant extant examples of some of the earliest and most ornate reinforced-concrete bridges.[70] Particularly significant groups of park bridges are found in Minneapolis, St. Paul, and Duluth. Early stone-faced, reinforced-concrete, arch bridges survive as a unique, linear group on so-called "Seven Bridges Road" in Duluth. In Minneapolis, Minnehaha Parkway and the Lake District provide park-bridge examples, as do Como and Phalen parks in St. Paul.

"New Deal" Era Bridges

During the administration of President Franklin Delano Roosevelt, 1933-45, generally referred to as the "New Deal" era, a number of federal programs were created to provide Depression Era work for the unemployed and to stimulate private business. Among the many programs, for example, was the Works Progress Administration (changed in 1937 to Works Projects Administration and both known popularly as "WPA"), funded bridge construction, along with many other highway and transportation projects. The WPA was abolished in 1942, its work being absorbed by the Federal Works Agency. During that period it built some 78,000 bridges nationally, and built or improved 1,400 bridges in Minnesota.[71] For the period 1935-39, before World War II forced the nearly total cessation of bridge construction, the WPA in Minnesota reported building 176 new bridges and improving an additional 324 bridges.[72]

In part because of wartime steel shortages, WPA bridges usually were built of stone, wood, or concrete. At times, they incorporated traditional stone masonry as a way of providing employment. Instead of eliminating labor costs as in traditional bridge building economics, this was an explicit attempt to make the construction projects labor-intensive, thus creating more work. On occasion, this produced seeming anachronisms-stone-arch bridges. In other examples, a finely wrought stone-veneer was applied to a concrete structure.

WPA bridges usually were designed in one or the other of two contemporary architectural style trends: a rustic, traditional style, or a WPA/government Deco Moderne style. The first style looked backward while the other looked ahead. New Deal era bridges might be large or small. Because the WPA funded park projects, many WPA bridges were built in park or park-like settings. These bridges would be built in a version of the rustic mode, either in stone or wood. Here, the WPA bridge category overlaps with the park-bridge category. Other WPA bridges followed the Moderne styles that had been developing prior to the advent of the federal relief programs. A 1939 pictorial summary of Minnesota WPA projects depicts bridges of both varieties. The Moderne examples have pipe railings with masonry posts, a railing design often found on earlier bridges that were remodeled during the 1930s (whether WPA or not).[73]

Notes

1. Edwin C. Eckel, "Cement Production and Manufacture in the United States," in Engineering Magazine 30 (February 1906): 717-18.

2. See remarks of Carl Gayler (p. 467) following paper of Fritz von Emperger, "The Development and Recent Improvement of Concrete-Iron Highway Bridges," with discussion, in American Society of Civil Engineers Transactions 31 (1894): 438-83.

3. Discussion on concrete adapted from Wisconsin, Department of Transportation, Historic Highway Bridges in Wisconsin, Vol. 1, Stone and Concrete-Arch Bridges, by Jeffrey A. Hess and Robert M. Frame III (1986), pp. 187-205.

4. Carl W. Condit, American Building Art: The Nineteenth Century (New York: Oxford University Press, 1960), pp. 246-47.

5. Carl W. Condit, American Building Art: The Twentieth Century (New York: Oxford University Press, 1961), pp. 196-98, and American Building Art: The Nineteenth Century, p. 340.

6. Carol Poh Miller, "The Rocky River Bridge: Triumph in Concrete," in IA: Journal of the Society for Industrial Archeology 2 (1976), pp. 47-58.

7. Howard Newlon, Jr., "Evolution of Concrete Structures," Structural Renovation and Rehabilitation of Buildings, Papers from a Lecture Sponsored by the Boston Society of Civil Engineers Section/ASCE in Cooperation with the Massachusetts Institute of Technology, Oct. 9-Nov. 13, 1979, p. 91.

8. The reinforcing types, including patents and illustrations, are listed and described in Newlon Evolution of Concrete Structures, pp. 100-05; "Reinforced Concrete," in Scientific American Supplement No. 1547 (August 26, 1905): 24784-85 (includes illustrations of a number of reinforcing systems); "Forms of Concrete Reinforcement," in Iron Age 77 (January 11, 1906): 193-97 (includes discussion and illustrations of many reinforcing forms and bars); A. E. Lindau, "The Development of Concrete Reinforcement," Parts I & II, in Concrete 29 (October 1926): 34-38, and (November 1926): 22-24 (includes discussion and illustrations of reinforcing forms and bars); and F. E. Turneaure and E. R. Maurer, Principles of Reinforced Concrete Construction, 4th ed.(New York: John Wiley & Sons, 1936; first published in 1907), pp. 24-25. For an overview of an example of manufacturing and fabricating an early reinforcing bar, the process used to manufacture the Kahn bar, see "Making Pressed-Steel Reinforcing," in Iron Trade Review 64 (April 24, 1919): 1073-80, which reviews the Youngstown, Ohio, plant of Truscon Steel Co., founded by Julius Kahn about 1902 as the Trussed Concrete Steel Co. with a plant in Detroit. It was originally designed to manufacture the Kahn reinforcing bar. In 1907 the Youngstown plant was opened and the name was changed in 1918. Eventually it produced a variety of pressed metal products, including shells for gas bombs during World War I. For a discussion of the bending and placing of reinforcing bars, see section 3 in George A. Hool and W. S. Kinne, eds., Reinforced Concrete and Masonry Structures (New York: McGraw-Hill Book Co., 1924). George M. Cheney, Indianapolis, Indiana, and received Letters Patent

No. 820,921 in 1906, and his patent was assigned to the Standard Reinforced Concrete Company, of Indianapolis, Indiana. His patent subsequently was used in Minnesota Bridge 112366, Beltrami County, and is documented in the Mn/DOT files for that bridge.

9. See Newlon "Evolution of Concrete Structures," pp. 99-104.

10. See Newlon "Evolution of Concrete Structures," pp. 99-104.

11. Carl Condit, American Building (Chicago: University of Chicago Press, 1968), pp. 171-74; Newlon, "Evolution of Concrete Structures," p. 100.

12. Condit, American Building: The Twentieth Century, p. 250; Condit's information is from Josef Melan, Plain and Reinforced Concrete Arches, authorized translation by D. B. Steinman (New York: John Wiley & Sons, Inc., 1917), opposite p. 7. For a more complete discussion see William Mueser, "The Development of Reinforced Concrete Bridge Construction," in The Cornell Civil Engineer, 33 May 1925): 162-63. It is now reported to be located in a Rock Rapids city park.

13. See discussion and example in C. B. McCullough, Economics of Highway Bridge Types (Chicago: Gillette Publishing Co., 1929), pp. 97, 112.

14. Condit, American Building, 1968, p. 175.

15. Miller, p. 49.

16. Condit, American Building, 1968, p. 251.

17. Newlon, "Evolution of Concrete Structures," p. 100; Condit, American Building, 1968, p. 252; and Julius Kahn, "Concrete Reenforcement," in Railroad Gazette 35 (October 16, 1903): 734-36. For a contemporary discussion of the manufacture of Kahn bars, see "Making Pressed-Steel Reinforcing," in Iron Trade Review 64 (April 24, 1919): 1073-80, on Kahn's Truscon factory in Youngstown, Ohio.

18. Paul B. Israel, "Spanning the Golden State: A History of the Highway Bridge in California," M.A. thesis, University of California--Santa Barbara, 1980, pp. 155-57.

19. See Condit, American Building Art: The Twentieth Century, p. 197, who doesn't give any explanation for the reference to Germany in his notes. Luten was based in Indianapolis.

20. Never popular in the United States, the concrete hinged-arch design is best known through the spectacular and elegant work of Swiss engineer Robert Maillart. See David P. Billington, Robert Maillart's Bridges: The Art of Engineering (Princeton: Princeton University Press, 1979). This design employs metal hinges at the spring lines and at the crown of the arch. Since the arch is thicker at the haunches, the points of stress between the hinges, the three-hinged arch presents a very different profile from the fixed arch, which tends to be heavier where it meets the abutments. In his landmark 1916 work, Bridge Engineering (New York: John Wiley and Sons), J. A. L. Waddell found the hinged

arch to be aesthetically awkward, but safe (p. 941). There are no known examples of concrete hinged-arch bridges in Minnesota.

21. Condit, American Building Art: The Twentieth Century, p. 204-05.

22. Condit, American Building, 1968, p. 251.

23. Jasper O. Draffin, "A Brief History of Lime, Cement, Concrete, and Reinforced Concrete," in University of Illinois Bulletin 40 (June 29, 1943): 36.

24 Condit, American Building, 1968, pp. 258-61.

25. Milo S. Ketchum, The Design of Highway Bridges of Steel, Timber and Concrete, 2nd ed., rewritten (New York: McGraw-Hill Book Co., Inc., 1920), p. 1; C. B. McCullough, Economics of Highway Bridge Types (Chicago: Gillette Publishing Co., 1929), pp. 108113.

26. Daniel B. Luten, "A Reinforced Concrete Girder Highway Bridge of 40 ft. Span," in Engineering News 55 (May 10, 1906): 517-18.

27. C. B. McCullough, Economics of Highway Bridge Types, p. 52.

28. Condit, American Building Art: The Twentieth Century, p. 207-08.

29. Frederick W. Taylor and Sanford E. Thompson, A Treatise on Concrete Plain and Reinforced (New York: John Wiley & Sons, Inc., 1917 [copyright 1916]), p. 694.

30. Ketchum, Design of Highway Bridges, pp. 273, 345; Hool and Kinne, Reinforced Concrete and Masonry Structures, p. 397; and Frederick W. Taylor, Sanford E. Thompson, and Edward Smulski, Reinforced Concrete Bridges (New York: John Wiley & Sons, Inc., 1939), p. 29. Falling in the middle is Clement C. Williams, The Design of Masonry Structures and Foundations (New York: McGraw-Hill Book Company, 1922), who states that "reinforced concrete slab bridges may be used advantageously for spans of about 12 to 24 ft. and are sometimes built up to 30 ft although the girder type will usually be found the more economical for spans above 24 ft." (pp. 331-32).

31. Waddell, Economics of Reinforced-Concrete Bridges (New York: John Wiley and Sons, Inc., 1921), pp. 220-21; Taylor, Thompson, Smulski, Reinforced-Concrete Bridges, pp. 35-36.

32. "Claude Allen Porter Turner," in A Selection of Historic American Papers on Concrete, 1876-1926, Howard Newlon, Jr., ed. (Detroit: American Concrete Institute, 1976), p. 243; C. A. P. Turner, Concrete Steel Construction (Minneapolis: Farnham Printing & Stationery Company, 1909); and C.A.P. Turner, "The Mushroom System as Applied to Bridges," in Cement Age (January 1910): 7-12.

33. Art Werthauser and Eriks V. Ludins, "Mississippi River Boulevard Bridge No. 92250: A Historical Report" (City of St. Paul, Dept. of Public Works, Bridge Bureau, June 1987). Copy in City Bridge Bureau office files. See also Turner, "The Mushroom System as Applied to Bridges."

34. Taylor, Thompson, Smulski, Reinforced Concrete Bridges, pp. 326-27.

35. See, for example, Hool and Kinne, Reinforced Concrete and Masonry Structures, pp. 397, 405-07, and Williams, Design of Masonry Structures and Foundations, pp. 332-40.

36. F. E. Turneaure and E. R. Maurer, Principles of Reinforced Concrete Construction, 4th ed. (New York: John Wiley and Sons, Inc., 1936), p. 54; an almost identical statement is found in Waddell, Bridge Engineering, p. 961.

37. "In deck girder designs, the cross section of the main girders in the center of each span is usually a T-beam, the floor slab forming the compression flanges." Taylor, Thompson, Smulski, Reinforced Concrete Bridges, p. 152.

38. Taylor and Thompson, A Treatise on Concrete, p. 694.

39. Ketchum, Design of Highway Bridges, pp. 273, 354.

40. Minnesota Highway Commission, Report, 1915-16 (St. Paul, 1917), pp. 19-23; "Test of New Type of Reinforced-Concrete Bridge," Engineering News 76 (Sept. 28, 1916): 62021.

41. Taylor and Thompson, A Treatise on Concrete, p. 694.

42. Condit, American Building Art: The Twentieth Century, p. 208.

43. J. A. L. Waddell, Economics of Bridgework, pp. 221-22.

44. George A. Hool and W. S. Kinne, eds., Reinforced Concrete and Masonry Structures, p. 428.

45. See Milo S. Ketchum, The Design of Highway Bridges of Steel, Timber and Concrete, 2nd ed., rewritten (New York: McGraw-Hill Book Co., Inc., 1920), pp. 275, 375; , George A. Hool and W. S. Kinne, eds., Reinforced Concrete and Masonry Structures, pp. 405-432; and Taylor, Thompson, and Smulski, Reinforced-Concrete Bridges, pp. 93-94.

46. Taylor, Thompson, and Smulski, p. 93.

47. See discussions in Arthur G. Hayden, The Rigid-Frame Bridge (New York: John Wiley and Sons, Inc., 1931), pp. 1-4; Condit, American Building: The Twentieth Century, pp. 213-14; and Taylor, Thompson, and Smulski, Reinforced Concrete Bridges, pp. 26869.

48. Condit, American Building Art: The Twentieth Century, p. 213.

49. Hayden, pp. 170-73.

50. Taylor, Thompson, Smulski, Reinforced Concrete Bridges, p. 321 (separate frame, ribs), 148-62 (multi-span).

51. Remarks of Frank T. Sheets, reported in "Trend Toward Continuity in Bridge Design," in Concrete 46 (Nov. 1938): 8.

52. See Sam Bass Warner, Jr., Streetcar Suburbs: The Process of Growth in Boston, 1870-1900 (Cambridge: Harvard University Press and The MIT Press, 1962).

53. "Reinforced Concrete Arch Bridges, Como Park, St. Paul," in Engineering Record 50 (Dec. 3, 1904): 648-49; Henry Grattan Tyrrell, Concrete Bridges and Culverts (Chicago: Myron C. Clark Publishing Co., 1909), pp. 163-66; A Guide to the Industrial Archeology of the Twin Cities, Nicholas Westbrook, ed. (St. Paul & Minneapolis: Society for Industrial Archeology, 1983), p. 18; the background and accomplishments of William S. Hewett and the Hewett firms are discussed in Fredric L. Quivik, "Montana's Minneapolis Bridge Builders," in IA: The Journal of the Society for Industrial Archeology 10 (1984): 35-54.

54. Condit, American Building: The Nineteenth Century, p. 250. Condit's information is from Josef Melan, Plain and Reinforced Concrete Arches, authorized translation by D. B. Steinman (New York: John Wiley & Sons, Inc., 1917), opposite p. 7. Von Emperger's major article on the subject, read and published in 1894, makes no mention of any bridges in Iowa or elsewhere in the Midwest (see von Emperger, "The Development and Recent Improvement of Concrete-Iron Highway Bridges," with discussion, in American Society of Civil Engineers Transactions 31 [1894]: 438-83). However, the Rock Rapids bridge project is recounted in William Mueser, "The Development of Reinforced Concrete Bridge Construction," in The Cornell Civil Engineer, 33 (May 1925): 162-63. On the possibility that Gillham and Hewett met in the 1880s, see statements on the Ash Creek bridge in the Rock County Commissioners Minutes' for March 29, 1883, and December 26, 1884.

55. See discussion in Robert M. Frame III, "Historic Bridge Project" A Report to the Minnesota State Historic Preservation Office (1985) pp. 22-29.

56. See discussion in Frame, Historic Bridge Project Report, pp. 24-26.

57. George H. Herrold, "Reinforced Concrete Highway Bridges," in Tenth Bulletin of the Minnesota Surveyors' and Engineers' Society (1912-13), pp. 84-86.

58. See Frame, Historic Bridge Project Report, p. 27.

59. Minnesota Highway Commission, Report for 1915-16 (St. Paul, 1917), pp. 23-24.

60. Minnesota Highway Commission, Report of the Commissioner of Highways for 1929-30 (St. Paul, 1931), p. 11.

61. M. J. Hoffmann, "Minnesota Trunk Highway Bridge Construction," in The Minnesota Federation of Architectural and Engineering Societies Bulletin 26 (April 1931): 13-18; Minnesota Highway Commission. Report of the Commissioner of Highways for 1920 (St. Paul, 1921), pp. 7-8, and Report of the Commissioner of Highways for 1922 (St. Paul, 1922), p. 17.

62. David Cuming, Discovering Heritage Bridges on Ontario's Roads (Erin, Ontario: Boston Mills Press, 1983), pp. 51-56.

63. Minnesota Highway Commission, Report of the Commissioner of Highways for 1929-30 (St. Paul, 1931), p. 6 (Anoka); Report of the Commissioner of Highways for 1931-32 (St. Paul, 1932), frontispiece (Brainerd); Biennial Report of the Commissioner of Highways for 1933-34 (St. Paul, 1934), frontispiece (Redwood Falls); and Biennial Report of the Commissioner of Highways for July 1, 1940 to June 31, 1942 (St. Paul, 1942), frontispiece (Fon du Lac) and p. 41 (Anoka).

64. George M. Shepard, "Twin City Bridge Construction," in Minnesota Techno-Log 7 (Feb. 1927): 137.

65. Discussed in Westbrook, "Bridges," pp. 14-29, who quotes Plowden; see also Condit, American Building: Twentieth Century, pp. 201-02, and Kenneth Bjork, Saga in Steel and Concrete: Norwegian Engineers in America (Northfield, Minn.: Norwegian-American Historical Association, 1947), pp. 138-55; for further details, consult Appendix A, "Engineers, Fabricators, Builders and Contractors Active in Minnesota Bridge Building," in Frame, Historic Bridge Project Report.

66. See park-bridge discussion in Wisconsin Department of Transportation, Hess and Frame, Stone and Concrete-Arch Bridges, pp. 233-35. Tractenberg, p. 111.

67. Henry Grattan Tyrrell, "American Park Bridges," in The American Architect, March 1901, pp. 100-01.

68. Tyrrell, "American Park Bridges," p. 99.

69. Along with Tyrrell's volume, see also Gilmore D. Clarke's essay on "The Architecture of Short-Span Bridges" in Hayden, The Rigid Frame Bridge, pp. 193-232. The rigid frame originally was introduced as a parkway bridge and it often has been used in this capacity, substituting for the concrete arch and receiving the same architectural treatment. See also the many ornamental bridges in the important volume by Wisconsin engineer Charles S. Whitney, Bridges: A Study in Their Art, Science and Evolution (New York: W. E. Rudge, 1929; reprinted New York: Greenwich House, 1983).

70. For a discussion of a significant and influential park system and its bridges, see Marilyn E. Weigold, Pioneering in Parks and Parkways: Westchester County, New York, 1895-1945, Essays in Public Works History No. 9 (Chicago: Public Works Historical Society, February 1980).

71. U.S. Federal Works Agency. Final Report on the WPA Program, 1935-43 (Washington, D.C.: U.S. Government Printing Office, [1947]), pp. 53, 135.

72. Works Progress Administration of Minnesota, WPA Accomplishments: Minnesota 1935-39 (St. Paul: Works Progress Administration, 1939), unpaginated, see second page of section "Physical Accomplishments."

73. Works Progress Administration of Minnesota, WPA Accomplishments: Minnesota 1935-39, unpaginated, see section on "Minnesota Highways."

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