

Pedestrian Railing Repair Study

REPORT OF FINDINGS

STILLWATER LIFT BRIDGE

(Mn/DOT Br. No. 4654 – Wis/DOT Br. No. M-61)
over St. Croix River



For:
Minnesota Department of Transportation
and
Wisconsin Department of Transportation

By:
HNTB Corporation

March 20, 2003

Pedestrian Railing Repair Study

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FOR

STILLWATER LIFT BRIDGE

(Mn/DOT Br. No. 4654 – Wis/DOT Br. No. M-61)

Over the St. Croix River

Stillwater, Minnesota / Houlton (St. Joseph Township), Wisconsin

March 20, 2003

This report presents the findings of consideration of various options to repair the pedestrian railing of the Stillwater Lift Bridge.

This document should not be considered as the final product, or conclusion, of historic preservation considerations. Application of the Secretary of Interior's Standards for Historic Preservation Projects will be applied as described within this document.

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly licensed professional engineer under the laws of the state of Minnesota.

Signed:  Reg. No. 17809

Printed Name: Richard M. Johnson Date: 3.20.03

Pedestrian Railing Repair Study

Report of Findings

Stillwater Lift Bridge

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Executive Summary

This report presents the findings of consideration of various options to repair the pedestrian railing of the Stillwater Lift Bridge. Consideration of repair options was made in anticipation of implementation of repairs to selected features of the bridge.

Consideration of repair of other features of the bridge, including the sidewalk support system, will be addressed in a separate and subsequent report.

In broad terms, 10% of the existing railing is considered to be in good condition, 50% in fair condition, and 40% in poor condition.

Four railing repair options were identified for consideration as described below:

Option 1 – Reconstruction: This option constitutes replacement of the railing in its entirety, in-kind to the extent possible. The replacement railing would be duplex coated (galvanized and painted).

Option 2 – Replacement with Contemporary Methods: This option constitutes replacement of the railing in its entirety, with contemporary fabrication methods and materials to emulate the existing railing. Again, the replacement railing would be duplex coated.

Option 3 – Blast Clean, Repair and Paint: This option constitutes blast cleaning the existing railing in-place, replacement of selected elements of the railing with similar elements on-site, on an as-needed basis as determined by inspection, and repainting the entire railing.

Option 4 – Repair and Spot Paint: This option is essentially identical to Option 3 except the existing railing will not be blast cleaned, and only the repaired portions of the railing would be spot painted.

The options were evaluated with respect to: 1) Relative Construction Costs, 2) Maintenance, 3) Historic Preservation and Appearance. The options were evaluated on a scale of 1 to 5, with 1 indicating low performance and 5 indicating high performance.

None of the options comply with the explicit requirements of current pedestrian railing design standards, but all are perceived to comply with the general intent of the American Association of State Highway Transportation Officials design standards.

The relative construction cost of each option was estimated. The results are presented below in Table 1.

Table 1: Relative Construction Costs in 2002 Dollars (US)

Option	Rel. Const. Cost	Cost per Lin. Ft.	% of Least Cost
1	\$215,000	\$215	179%
2	\$180,000	\$180	150%
3	\$210,000 ⁽¹⁾	\$210	175%
4	\$120,000 ⁽¹⁾	\$120	100%

1: Assumes uninterrupted access from the bridge deck for construction. If access from the bridge deck is not available, an additional \$25,000 is required to provide access from the river.

The results of the evaluation with respect to the evaluation criteria are presented below in Table 2.

Table 2 – Evaluation Rating Summary

Option	Rel. Const. Cost	Maintenance	Historic Preservation
1	1.0	5	3
2	2.5	5	1
3	1.2	3	5
4	5	1	5

Because construction costs are a comparatively small portion of the project budget it is suggested that construction cost not be used as a primary criterion to select the preferred option.

Options 1 and 2 ranked high with respect to maintenance, and relatively low with respect to historic preservation. Of the two options, Option 1 is considered more consistent with the repair goals than Option 2 primarily due to the historic preservation ranking.

Options 3 and 4 ranked high with respect to historic preservation, and relatively low with respect to maintenance. Of the two options, Option 3 is considered more consistent with the repair goals than Option 4 primarily due to the maintenance ranking.

Options 1 and 3 are recommended to be carried forward for further deliberation and ultimate selection of the preferred option bearing in mind the attributes related to:

- Historic Preservation
- Maintenance Effort
- Reconstruction of Ornamental Lighting
- Service Life

Presently the pedestrian railing is used on north side of Span 10 without benefit of a traffic guard rail or traffic barrier to restrain errant vehicles. It is recommended that a traffic guard rail or traffic barrier be constructed on north side of Span 10. The traffic barrier could be design to be architecturally consistent with original design should that be deemed desirable.

A more in-depth application of the Secretary of Interior's Standards for Historic Preservation Projects will take place at public meetings with the State Historic Preservation Offices (SHPO) of Minnesota and Wisconsin, the Cultural Resources staff of the Minnesota and Wisconsin Departments of Transportation, and local preservation groups. The results of those discussions will be taken into consideration as the options are selected. A narrative discussion that integrates the Secretary's Standards as they apply to the proposed options and to the overall preservation of the bridge property will appear in the *Stillwater Lift Bridge Repair Needs, Report of Findings*. This work is being completed by a historian that meets the Secretary of Interior's Professional Standards, in collaboration with the lead consulting engineer.

[Based on review of a draft version of this report, Mn/DOT's Office of Bridges and Structures suggested that Option 1 and 4 be carried forward for further deliberation and ultimate selection of the preferred option, but is open to all options and seeks addition input from other agencies].

Introduction

The states of Minnesota and Wisconsin, acting through the Minnesota Department of Transportation (Mn/DOT), have engaged HNTB Corporation to evaluate various options for the repair of the existing pedestrian railing of the Stillwater Lift Bridge (a.k.a. St. Croix River Bridge at Stillwater, Mn/DOT Br. No. 4654 and Wis/DOT Br. No. M-61) for purposes of determining a repair strategy.

The railing was inspected simultaneously with other structural elements of the bridge. The findings of HNTB's structural (non lift-bridge specific) inspection and evaluation are documented in a separate report titled: *Structural Inspection and Preliminary Condition Evaluation, (Rev 1) Report of Findings, Volumes 1 and 2*, dated March 17, 2003.

This report addresses only the pedestrian railing which is comprised of elements in a vertical plane along the downstream (south) edge of the sidewalk and the associated knee braces. Other structural elements, including the sidewalk support brackets, sidewalk stringers and associated connections will be addressed in a separate and subsequent report.

The railing on Spans 1 and 2 consist of an ornamental concrete railing and will not be addressed within this report.

It is recognized that historic preservation considerations must address individual elements of the bridge, those elements within the context of the bridge, and the bridge as a whole. This report addresses only the individual element of the bridge, that being the pedestrian railing. Application of the Secretary of Interior's Standards for Historic Preservation Projects will be addressed as described within this report under Historic Preservation.

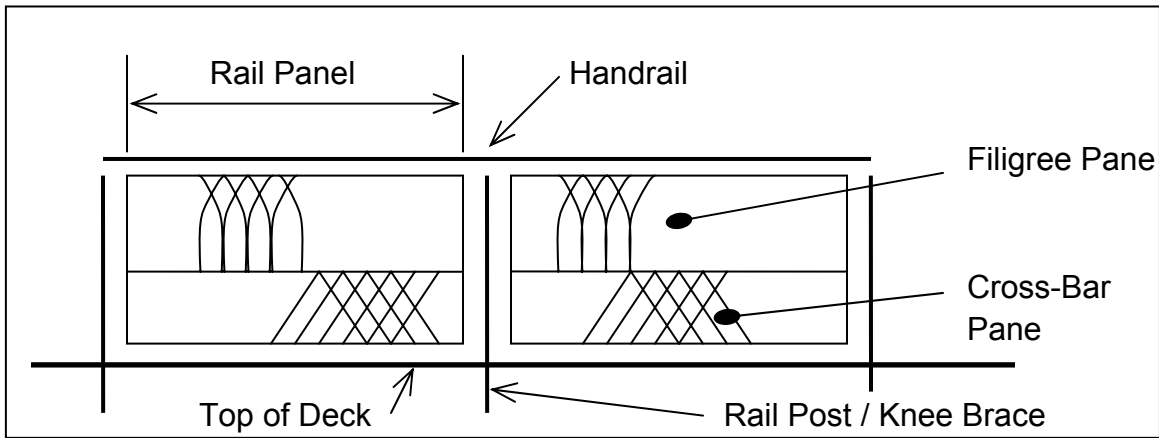
Four options are presented within this report for consideration. Each of the options is evaluated with respect to relative construction cost, maintenance and historic preservation.

Observations regarding compliance with pedestrian railing design standards are provided within this report for informational purposes.

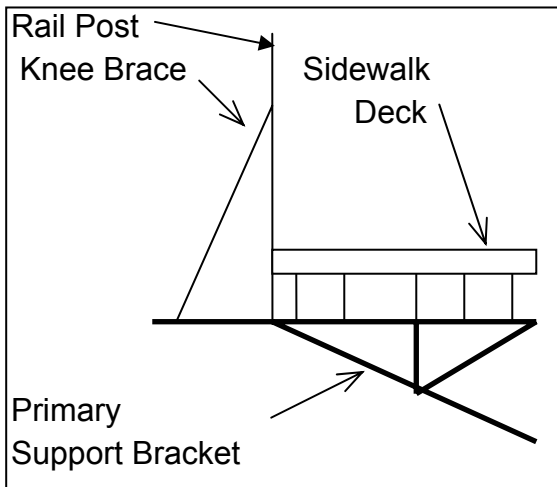
Schematic graphical representation of the condition of the railing is presented in Appendix A. Representative photographs are presented in Appendix B.

Existing Pedestrian Railing and Condition

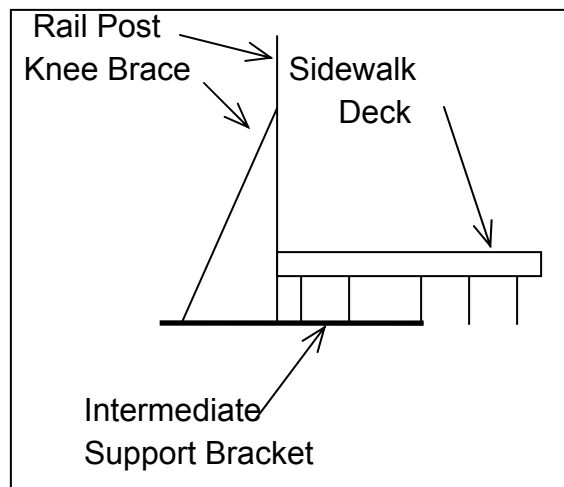
The pedestrian railing is primarily of original construction and supported at 10-foot spacing by rail posts and knee braces resulting in nominal 10-foot railing panels. The rail posts/knee braces are in turn supported by primary sidewalk support brackets located at each floorbeam with 20-foot spacing and by intermediate diaphragm support brackets, also at 20-foot spacing. (Ref. Photo 1). Within any given truss span, there are 14 railing panels, 14 rail posts consisting of back-to-back channels and a single newel post (Ref. Photo 4). Provided below are schematic representations of the pedestrian railing.



Schematic Elevation - Pedestrian Railing



**Schematic Section
Primary Support Bracket**



**Schematic Section
Intermediate Support Bracket**

The newel posts are ornate and of original construction and consist of hollow cast-iron elements. The newel posts originally incorporated an anchorage assembly for ornamental lights on top of each post. The ornamental lights have been removed. A metal plate has been welded to the top of the newel posts to cover the remnants of the lighting anchorage assembly (Ref. Photo 7). The newel posts are fastened to supporting structural members with bolted connections and supported laterally (transverse to the centerline of the bridge) with knee braces. The supporting elements of several newel posts are damaged in the form of broken mounting flanges and missing or broken anchorage bolts. (Ref. Photo 14).

Each railing panel has three horizontal members – a handrail on the top consisting of a 3-inch pipe connected to a legs-up channel, an intermediate horizontal member consisting of back-to-back legs-down angles, and a lower horizontal member consisting of back-to-back legs-up angles at the bottom.

Each railing panel has two panes comprised of intersecting elements. The upper pane of the railing panel consists of filigree work fabricated of back-to-back angles bent to a 1'-9" radius and riveted together at intersecting points. The lower pane of the railing panel consists of notched 2-1/2" flat stock oriented at 45 degrees to form cross-bar lattice work.

The existing railing on the north and south side of Span 10 was originally intended to be constructed of ornamental concrete railings similar to that constructed on Spans 1 and 2. However, Span 10 railings presently consist of construction similar to the pedestrian railing on the truss spans. Presumably the Span 10 railings were changed from ornamental concrete to metal due to the addition of Span 10 to address the foundation problems of the east abutment. The design of the railings on Span 10 was intended to serve as pedestrian railings. The railing on the north side is effectively serving as a traffic barrier. The absence of suitable traffic barriers does not conform to present American Association of State Highway Transportation Officials (AASHTO) design standards.

The present condition of the railing is documented in the previously referenced structural inspection and preliminary condition evaluation report. A graphical summary of the present condition is provided in Appendix A. Provided in Table 4 on page 7 is a quantitative summary of the condition of the railing. The condition evaluation coding used for elements is provided in Table 3, also on page 7. For

purposes of comparison to condition evaluation codes, a generalized National Bridge Inspection (NBI) equivalent condition evaluation coding is provided.

Table 3 – Element Condition Evaluation Coding

Condition	Numeric Condit. Code	NBI Equil. Condit. Codes	Broad Narrative Definitions
Good	3	9, 8, 7	Element is limited to only minor problems.
Fair	2	6, 5	Structural capacity of element is not affected by minor deterioration, section loss, spalling, cracking, or other deficiency.
Poor	1	4, 3, 2	Structural capacity of element is affected or jeopardized by advanced deterioration, section loss, spalling, cracking, or other deficiency.

Table 4 – Railing Condition Rating

Item	Total No.	Good Condition	Fair Condition	Poor Condition	Perc. Good	Perc. Fair	Perc. Poor
Hand Rail	100	36	59	5	36%	59%	5%
Rail post	98	12	2	84	12%	2%	86%
Newel Post	10	0	5	5	0%	50%	50%
Filigree Pane	100	4	75	21	4%	75%	21%
Cross-Bar Pane	100	4	61	35	4%	61%	35%

In broad terms, the findings presented in Table 4 can be interpreted, by arithmetic averaging, to conclude that 10% of the existing railing is in good condition, 50% in fair condition, and 40% in poor condition.

Options Defined

Four options have been identified to address the repair of the pedestrian railing. Graphic representation of Options 1 and 2 are provided in Figures A and B respectively, provided immediately following the narrative description. The railing repair options considered are briefly described below.

Option 1 – Reconstruction: This option constitutes replacement of the entire railing in-kind to the extent possible.

Railing Panels: The railing panels would be fabricated of individual elements (angles, channels, bars) fastened together with through-bolts in lieu of rivets. The through-bolts would have a rounded-head on one side to emulate the existing rivet button heads. The opposite side of the through-bolt would have a conventional washer and hex nut. To the extent possible, the rounded-head of the bolts would be positioned to face pedestrian traffic.

Each individual element of the railing would be hot-dipped galvanized prior to assembly. Once the railing galvanized elements are assembled (with through-bolts), they would be painted. The combination of galvanizing and painting is referred to as duplex coating.

Rail Posts and Knee Braces: Similar to the railing panels, the rail posts would be replaced with duplex coated back-to-back channels fastened together with rounded-head through-bolts. The knee braces would be replaced with t-sections.

Newel Posts: The newel posts would be replaced in-kind with cast-iron castings suitable for supporting ornamental lighting.

Replacement of the railing in-kind is estimated to require the follow elements:

100	Railing Panels – 10-foot nominal length
98	Rail Posts and Knee Braces
10	Newel Posts

Option 2 – Replacement with Contemporary Methods: This option constitutes replacement of the entire railing with contemporary fabrication methods and materials to emulate the existing railing and conform to AASHTO design standards. The replacement railing would be fabricated in sections and then hot-dipped galvanized rather than galvanizing the individual elements prior to assembly. The galvanized sections would be painted subsequent to galvanizing.

Railing Panels: The railing panels would be fabricated of elements similar to the original railing panels using contemporary materials and fabrication methods to reduce the cost and increase the life span of the panels.

The upper filigree pane of the railing panels would be fabricated of solid bars rather than back-to-back angles. The bars would be separated such that the bars do not come into contact with each other, thus eliminating the corrosion prone connections. The bars would be welded to the horizontal members. The spacing of the bars would be reduced to conform to AASHTO's standards.

The lower cross-bar pane of the railing panels would be fabricated of a single sheet of metal flame-cut to emulate the cross-bar pattern of the original lower pane. The flame-cut metal would be welded to the horizontal members.

Rail Posts and Knee Braces: The rail posts and knee braces would remain similar to the original design.

Newel Posts: The newel posts would be replaced with a weldment fabricated of structural tubing, angles and plates to emulate the original posts. The level of ornamentation, or embellishment, of the replacement newel posts would be substantially less than that of the original newel posts in the interest of reducing cost and corrosion prone details. The newel posts would be suitable for anchorage of ornamental lights.

Replacement of the railing with contemporary fabrication methods is estimated to require the follow elements:

100	Railing Panels – 10-foot nominal length
98	Rail Posts and Knee Braces
10	Newel Posts

Option 3 – Blast Clean, Repair and Paint: This option constitutes blast cleaning the entire existing railing in-place, replacement of selected corroded elements of the railing with similar elements on-site, on an as-needed basis as determined by inspection, and repainting the entire railing. Repairs would be accomplished by disassembly using the most expedient means available which may include; prying, torch cutting, mechanical cutting, and drilling. Assembly would also be accomplished by the most expedient means and is anticipated to consist primarily of welding and bolting.

From a practical standpoint, it is unlikely that the existing newel posts could be retrofitted to support ornamental lights without extraordinary effort to remove the welded cover plate and re-construct the light anchorage (presumed to be corroded).

Accurate identification of railing elements or segment to be replaced can only be made once the existing railing is blast cleaned. For purposes of this report, replacement of selected railing elements is considered to be as follows:

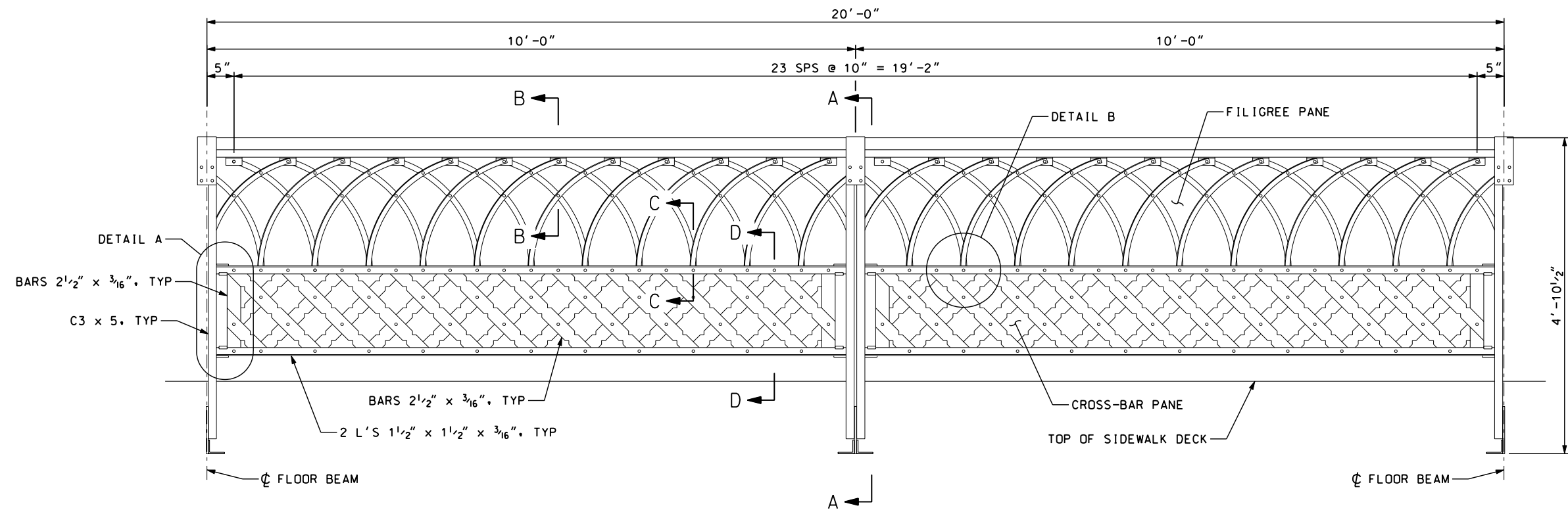
30	Handrail to Rail Post Connection Repair
30	Rail Post to Support Bracket Connection Repair
10	Handrail Replacement – 10-foot lengths (Pipe & channel)
30	Complete Rail Post & Knee Brace Replacement
30	Lower Horizontal Member Replacement – 10-foot lengths
30	Lower Cross-bar Pane Replacement – 10-foot lengths
20	Upper Filigree Pane Replacement – 10-foot lengths
100	Miscellaneous Individual Angle or Bar Stock Replacement

Option 4 – Repair and Spot Paint: This option is essentially identical to Option 3 except the existing railing will not be blast cleaned, and only the repaired portions of the railing would be spot painted.

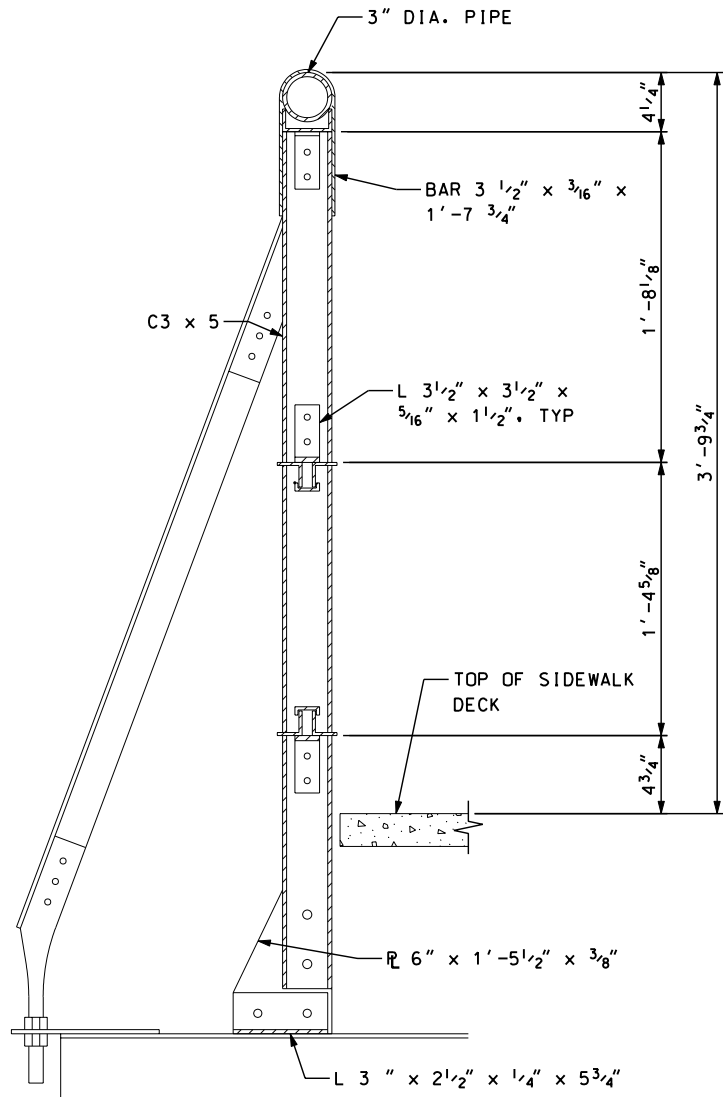
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For purposes of this report, replacement of selected railing elements is considered to be as follows:

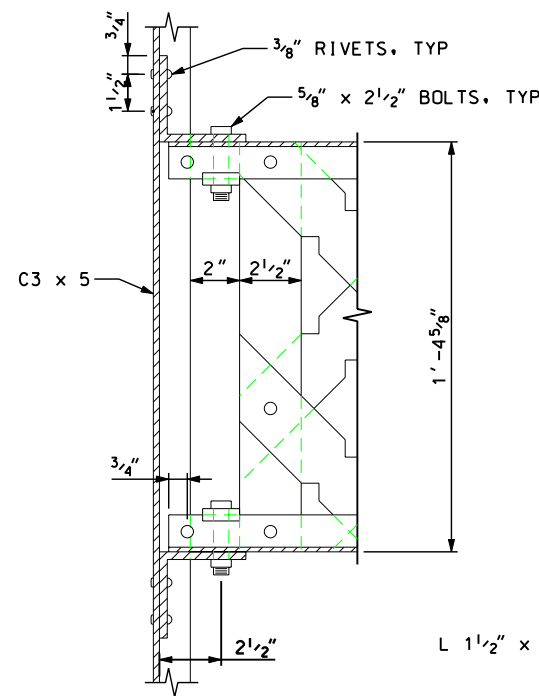
30	Handrail to Rail Post Connection Repair
30	Rail Post to Support Bracket Connection Repair
10	Handrail Replacement – 10-foot lengths (Pipe & channel)
30	Complete Rail Post & Knee Brace Replacement
30	Lower Horizontal Member Replacement – 10-foot lengths
30	Lower Cross-bar Pane Replacement – 10-foot lengths
20	Upper Filigree Pane Replacement – 10-foot lengths
100	Miscellaneous Individual Angle or Bar Stock Replacement



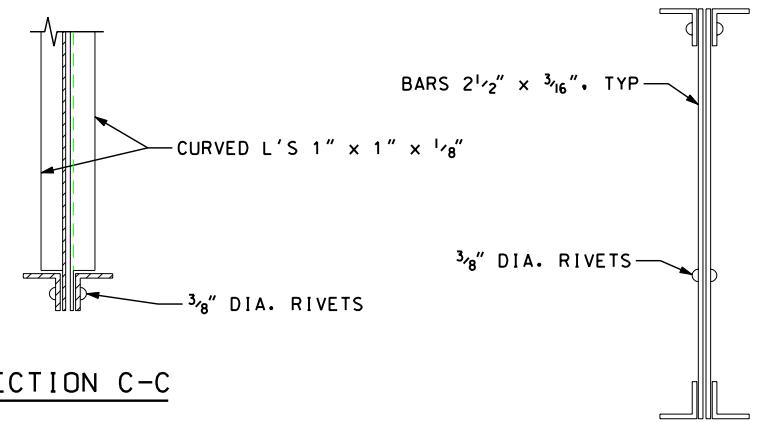
ELEVATION
LOOKING NORTH



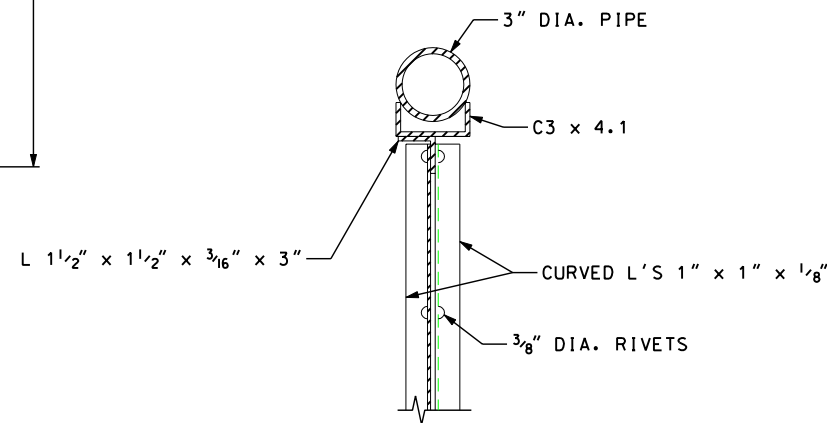
SECTION A-A



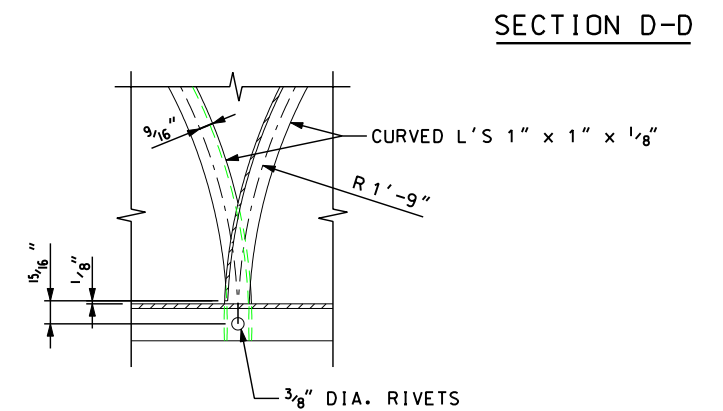
DETAIL A



SECTION C-C



SECTION B-B



DETAIL B

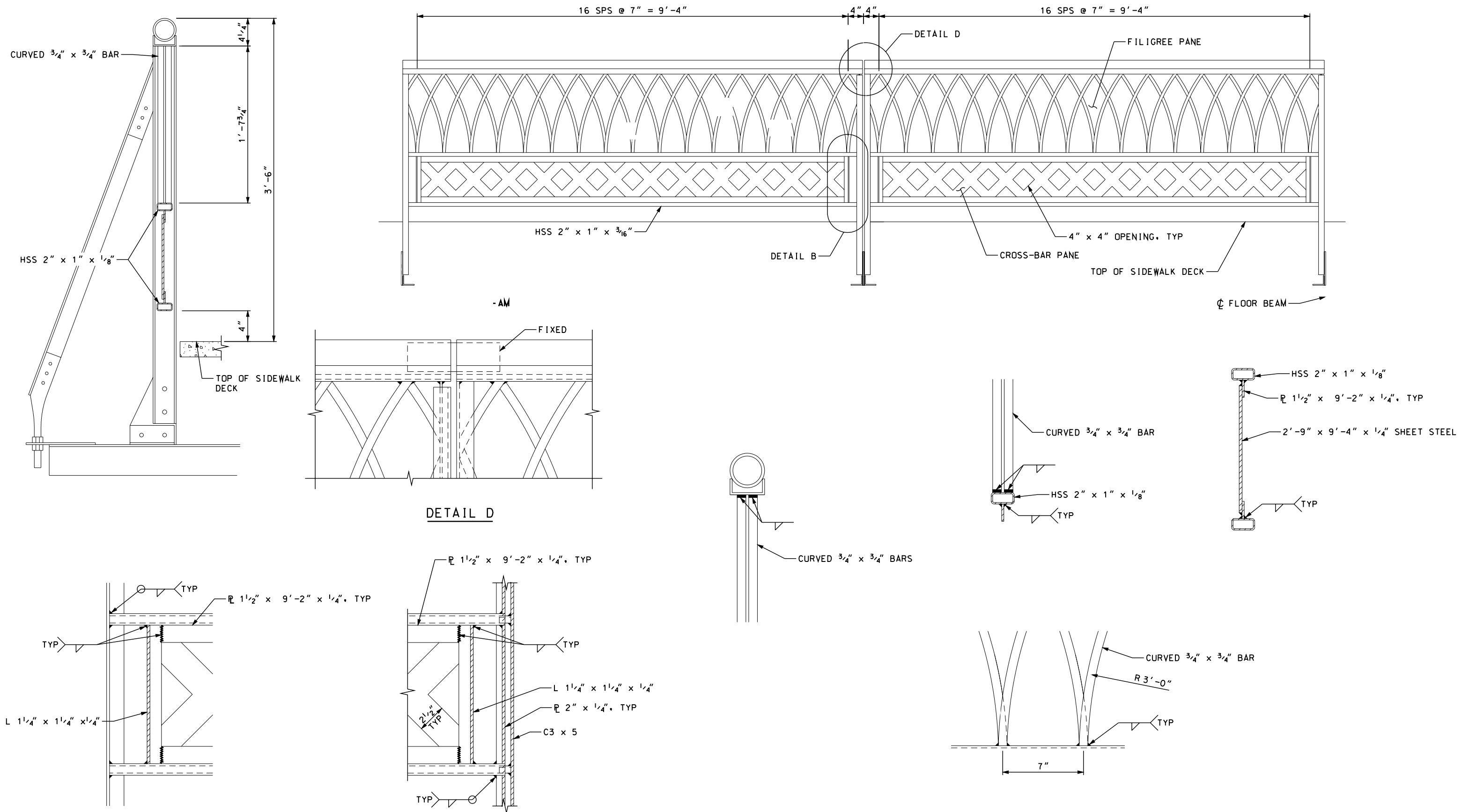
SECTION D-D

MARCH 2003



PEDESTRIAN RAILING REPAIR STUDY

FIGURE A : OPTION 1
RECONSTRUCTION



Evaluation Criteria

Each of the options identified was evaluated with respect to:

- Relative Construction Cost
- Maintenance
- Historic Preservation

Each criterion was rated on scale of 1 to 5, with 1 indicating low performance and 5 indicating high performance.

Evaluation of the pedestrian railing repair options is interrelated in some respects to repair of other aspects of the bridge. To the extent possible, an attempt has been made to segregate the railing repair considerations from the balance of the repair needs. As an example, the sidewalk support system has been identified as needing repair as documented under separate cover. The repair of the sidewalk support system will not be taken into account in the evaluation of the railing repair options.

Relative Construction Costs

Relative construction costs have been estimated for the various options using conceptual designs, gross estimate of quantities, discussions with a metal fabricator and engineering judgment. The cost analysis should not be construed as precise investigation, but rather as an indication of relative construction cost trends.

The cost of labor, equipment and materials for construction are subject to market forces including the bidding environment, which HNTB has no control over. No warranty or guarantee is provided or implied that the proposals, bids, or actual total project costs will not vary significantly from the opinions of costs presented herein.

Table 5 - Relative Construction Costs in 2002 Dollars (US)

Option	Rel. Const. Cost	Cost per Lin. Ft.	% of Least Cost
1	\$215,000	\$215	179%
2	\$180,000	\$180	150%
3	\$210,000 ⁽¹⁾	\$210	175%
4	\$120,000 ⁽¹⁾	\$120	100%

1: Assumes uninterrupted access from the bridge deck for construction. If access from the bridge deck is not available, an additional \$25,000 is required to provide access from the river.

Table 6 – Relative Construction Cost Ratings

Option	Evaluation Rating
1	1.0
2	2.5
3	1.2
4	5.0

Maintenance

Maintenance is evaluated on the basis of perceived effort to sustain the pedestrian railing in serviceable condition for 75 years into the future on the Stillwater Lift Bridge that is carrying vehicular traffic and subject to corrosive deicing chemicals.

Options 1 and 2 provide for replacement of the railing in its entirety. The maintenance related efforts are low due to the fact that these options are comprised of newly constructed material which is duplex coated. It is anticipated that these options would remain in serviceable condition without need for substantial maintenance effort for 75 years. At the conclusion of 75 years, it is believed that Option 2 would exhibit less corrosion than Option 1 because the details of the railing are less prone to collecting moisture.

Option 3 provides for the entire railing to be blast cleaned and painted with the intention of minimizing maintenance to the extent possible. It is anticipated that surface features of those portions of the railing that are presently corroded will compromise the new paint coating, and blast cleaning will not remove existing pack rust and areas prone to collect moisture. The result is anticipated to be a paint system that will deteriorate at isolated locations within 1 to 3 years of repair and continue to deteriorate at an accelerated rate. This will likely result in the need for additional maintenance in the form of painting and replacement of individual railing members or entire sections on a 10 to 15 year cycle, depending on the level of maintenance provided. It is anticipated the entire railing will need to be replaced, due to corrosion, within 40 years. This observation is based on the present condition of the railing with respect to its seventy-two years of service, the assumption that maintenance will be provided at a level consistent with past two decades, the fact that corrosion will continue at an accelerated rate, and the railing will be subject to corrosive deicing chemicals.

Option 4 requires only selected portions of the railing be replaced and repainted. This will leave a substantial portion of the railing in its present condition. The railing will continue to deteriorate at an accelerated rate. It is anticipated that the railing will require maintenance in the form of replacement of individual railing members or entire sections on a 2 to 5 year cycle, depending on the level of maintenance provided. It is anticipated the entire railing be replaced, due to corrosion, within 25 years.

It should be recognized that the cost of maintenance for Options 3 and 4 will be significantly higher than for Options 1 and 2. The cost of maintenance will be influenced by the level of upkeep provided, the extent of corrosive deicing chemicals applied to the bridge, and repair methods that are employed.

Provided below is the evaluation ratings for maintenance for the four options.

Table 7 – Maintenance

Option	Evaluation Rating
1	5
2	5
3	3
4	1

Historic Preservation

The majority of the existing railing is of original design and construction. Several elements of the railing have been repaired or replaced over the past several years due primarily to corrosion and/or damage.

Option 1 is perceived to preserve the feeling, character and appearance of the original construction, but not the original material of the railing itself.

Option 2 is perceived to preserve the general appearance of the original construction, but not the feeling and character of the original construction because of the simplified details and change in character of workmanship from “hand crafted” to “manufactured”. Option 2 also does not preserve the original material of the railing.

Options 3 and 4 retain the majority of the original material as well as the feeling, character and appearance of the original construction for the immediate future and for years beyond. It is anticipated that within several decades the essence of the original material will succumb to corrosion and require replacement.

Preservation of the feeling, appearance and character of workmanship of those portions of the railing repaired due to corrosion are highly dependent on level of care and diligence afforded by the individuals making the repairs. If the repairs are completed without regard to the historical significance of the railing, it is anticipated to result in loss of original material and appearance of the original construction. If the repairs are completed with due regard for the historical significance of the railing, the results are ultimately anticipated to result in that of Option 1.

Option 2 is rated at 1 out of 5 due to the loss of original material and character. Option 1 is rated at 3 out of 5 due to the preservation of feeling and character of the original construction. Options 3 and 4 are rated at 5 out of 5 due to the fact that the majority of the original railing is preserved for the immediate future.

A more in-depth application of the Secretary of Interior’s Standards for Historic Preservation Projects will take place at public meetings with the State Historic Preservation Offices (SHPO) of Minnesota and Wisconsin, the Cultural Resources staff of the Minnesota and Wisconsin Departments of Transportation, and local preservation groups. The results of those discussions will be taken into consideration as the options are selected. A narrative discussion that integrates

the Secretary's Standards as they apply to the proposed options and to the overall preservation of the bridge property will appear in the *Stillwater Lift Bridge Repair Needs, Report of Findings*. This work is being completed by a historian that meets the Secretary of Interior's Professional Standards, in collaboration with the lead consulting engineer.

Provided below is the evaluation ratings for historic preservation for the four options.

Table 8 – Historic Preservation

Option	Evaluation Rating
1	3
2	1
3	5
4	5

Standard Compliance

Presented below are observations related to compliance with pedestrian railing design standards for informational purposes. Compliance with pedestrian railing design standards is not anticipated to influence selection of the preferred option. For that reason, the options are not rated with regard to compliance to design standards.

AASHTO's Standard Specifications for Highway Bridges provides design standards for pedestrian railings. Among these standards are minimum dimensions between elements of a pedestrian railing. The standards require that a pedestrian railing be configured such that a 6-inch sphere cannot pass between railing elements within the lower 27-inches of the railing. The standards also require that the railing be configured such that an 8-inch sphere cannot pass between railing elements for those portions of the railing above 27-inches. The railing as originally designed, and as it exists today, does not meet the 6-inch sphere requirement of AASHTO standards.

Mn/DOT's published standards for design of pedestrian railings are more stringent than AASHTO's. Mn/DOT's standards apply a 4-inch sphere test to the lower 27-inches of the railing and a 6-inch sphere test above 27-inches.

Mn/DOT's and AASHTO's standards for pedestrian railings were developed as customary guidelines for the design of contemporary and ordinary bridges without guidance related to applications for historical bridges or other special applications. As such, they should be considered as guiding principles to follow under typical applications. Consideration of the repair or replacement of the pedestrian railing of the Stillwater Lift Bridge should be recognized as something other than a typical application. Mn/DOT may choose to deviate from its own standards and AASHTO's standards for the pedestrian railing as it deems prudent. It is anticipated that Mn/DOT would rely on site-specific conditions as well as the existence, or lack thereof, of problems associated with the configuration of the railing.

Options 1, 3 and 4 do not conform to the explicit requirements of Mn/DOT's or AASHTO's standards for pedestrian railings. Option 2 conforms to the explicit requirements of AASHTO's standards for pedestrian railings, but does not conform to Mn/DOT's standards for pedestrian railings. It is anticipated that Mn/DOT would allow application of Options 1 or 2 in recognition of historic status of the Stillwater Lift Bridge. It is also anticipated that Mn/DOT would not require

retrofit of the existing railing to comply with present design standards under application of Options 3 or 4.

It should be recognized that configuration of the existing railing does not conform to the intent, or the explicit requirements of AASHTO's design standards for bicycle railings due to the height of the railing. Therefore, none of the options considered should not be considered adequate for bicycle traffic.

Summary and Conclusions

Provided below is a summary of HNTB's evaluation ratings of the options with respect to the evaluation criteria. No attempt has been made to assign weight factors to the criterion because; application of the Secretary of Interior's Standard for Historic Preservation Properties has not been addressed within this report; the ranking of the options with respect to a given criterion is subjective; and application of anything other than equal weight factors to only three criterion will skew the findings of the evaluation.

Table 10 – Evaluation Rating Summary

Option	Rel. Const. Cost	Maintenance	Historic Preservation
1	1.0	5	3
2	2.5	5	1
3	1.2	3	5
4	5.0	1	5

While relative construction costs are always important, the relative construction costs of all the options fall within a \$100,000 range. This range is roughly 2% of the funds allocated for repair of the bridge. Because the relative construction cost of the options is small with respect to the overall project costs, and the costs fall within a relative narrow range, it is suggested that relative construction cost not be considered a primary discriminator between the options.

Considering only maintenance and historic preservation criterion, two of the four options ranked high with respect to maintenance, and the other two options ranked high with respect to historic preservation.

Of those options which ranked high with respect to maintenance, Option 1 is perceived to be more compliant with providing an extended service life and historic preservation than Option 2. For this reason, it is suggested that Option 2 be removed from further consideration.

Of those options which ranked high with respect to historic preservation, Option 3 is perceived to be more compliant with extending the service life and historic preservation than Option 4. For this reason, it is suggested that Option 4 be removed from further consideration.

Options 1 and 3 are recommended to be carried forward for further deliberation and ultimate selection of the preferred option bearing in mind the following overall attributes:

Option 1:

- Removes original construction from the bridge and is therefore counter to historic preservation goals.
- Reconstructs the original pedestrian railing in an attempt to mitigate loss of original construction.
- Affords the opportunity to place ornamental lighting on the newel posts.
- Results in low maintenance costs.

Option 3:

- Preserves the original construction and historic attributes of the railing.
- Effectively precludes replacement of ornamental lighting on the newel posts.
- Results in high maintenance costs.
- Anticipated to eventually result in loss of original construction in 40 years (subject to level of maintenance afforded and application of deicing chemicals).

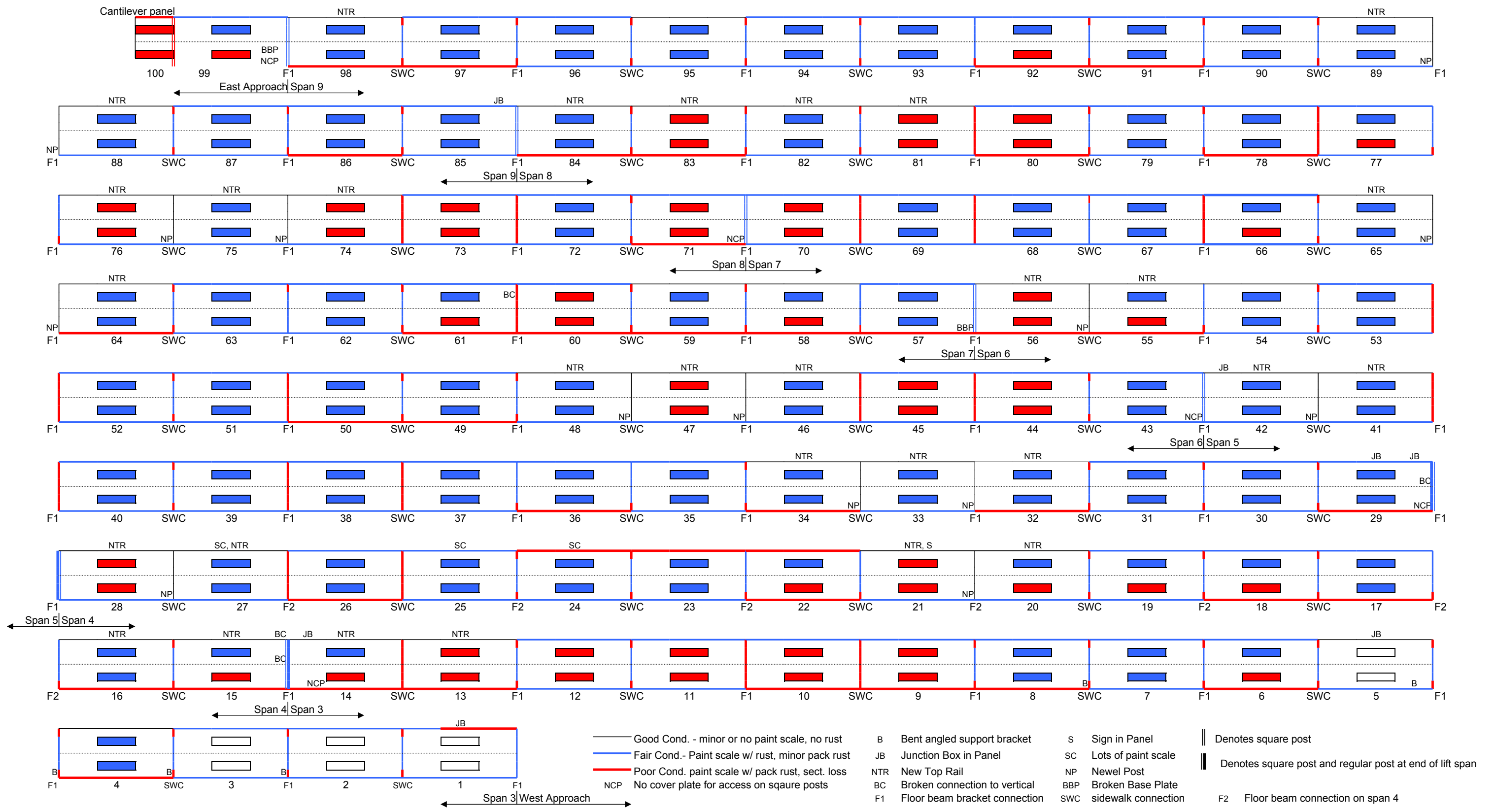
Additionally, the pedestrian railing presently fixed to the north side of Span 10 is recommended to be replaced with traffic barriers capable of restraining vehicles, or a suitable guard rail installed. The replacement traffic barrier could be constructed of concrete and detailed to be visually consistent with the other elements of the bridge, should that be deemed to be consistent with historic preservation.

[Based on review of a draft version of this report, Mn/DOT's Office of Bridges and Structures suggested that Option 1 and 4 be carried forward for further deliberation and ultimate selection of the preferred option, but is open to all options and seeks addition input from other agencies].

Appendix A: Graphic Representation Of Existing Condition

The existing condition of the railing is documented in the structural inspection report under separate cover and presented graphically within Appendix A.

- The elements depicted in red indicate significant paint scale, pack rust and/or section loss due to corrosion – poor condition.
- The elements depicted in blue indicate limited paint scale, pack rust and corrosion – fair condition.
- The elements depicted in black indicate good condition.



South Railing Elevation Looking South

Appendix B: Representative Photographs

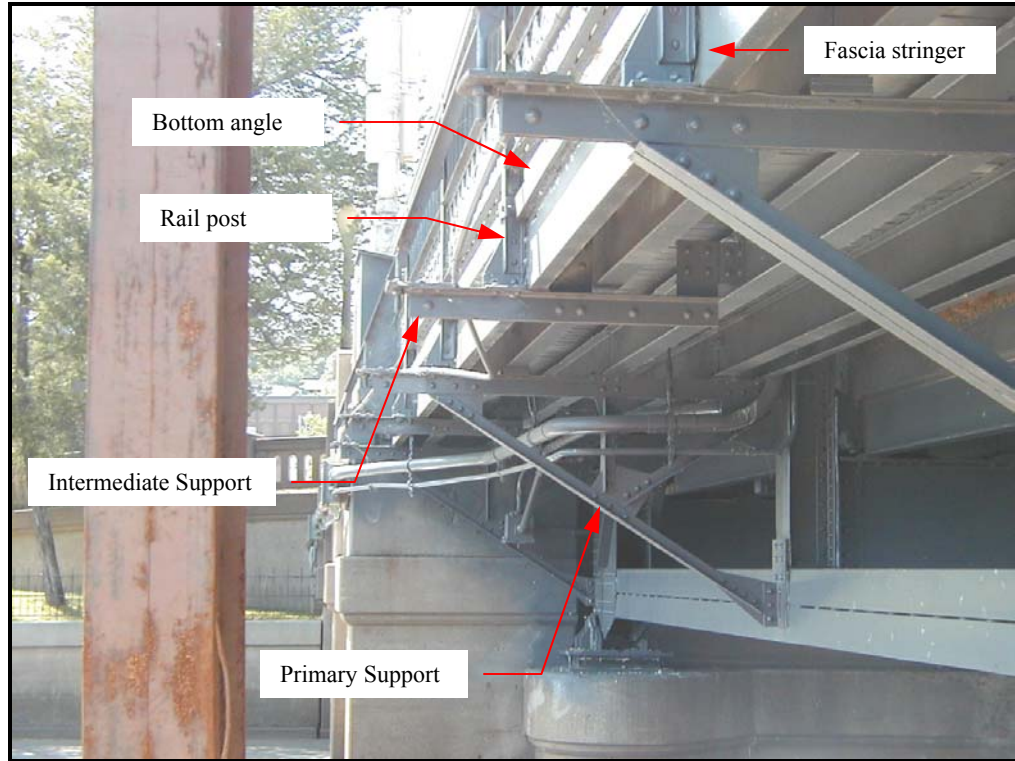


Photo 1: Sidewalk Support System

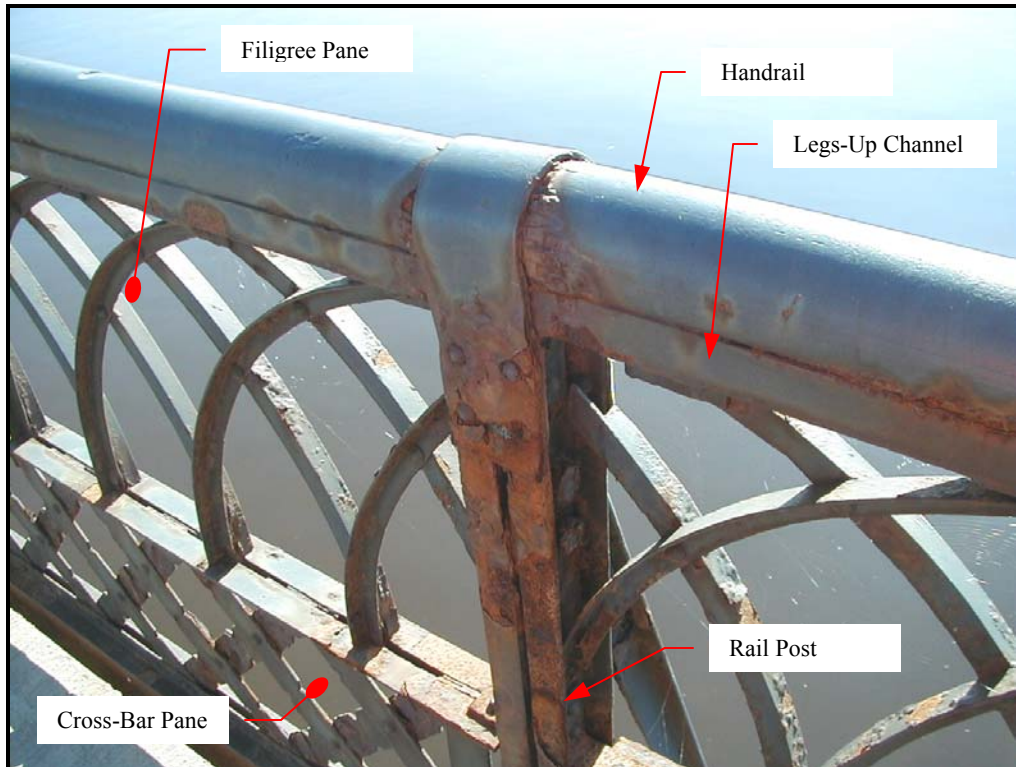


Photo 2: Original Railing Details



Photo 3: Pedestrian Railing Knee Brace



Photo 4: Typical Newel Post, Filigree and Cross-bar Panes

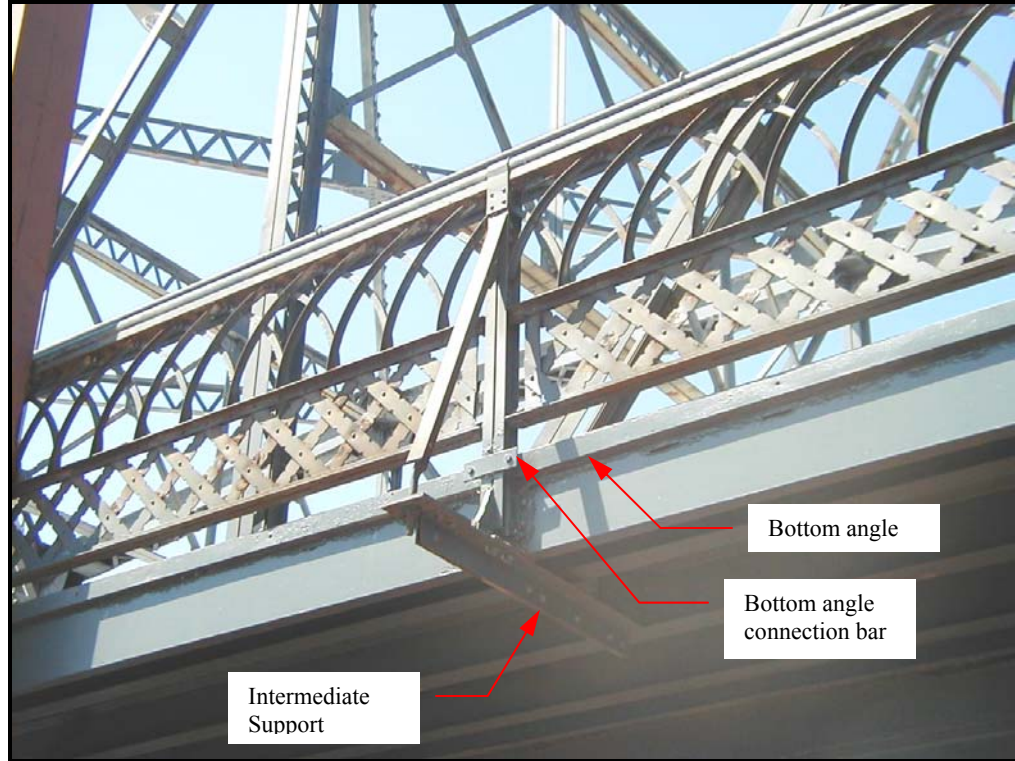


Photo 5: Intermediate Rail Post Support Bracket

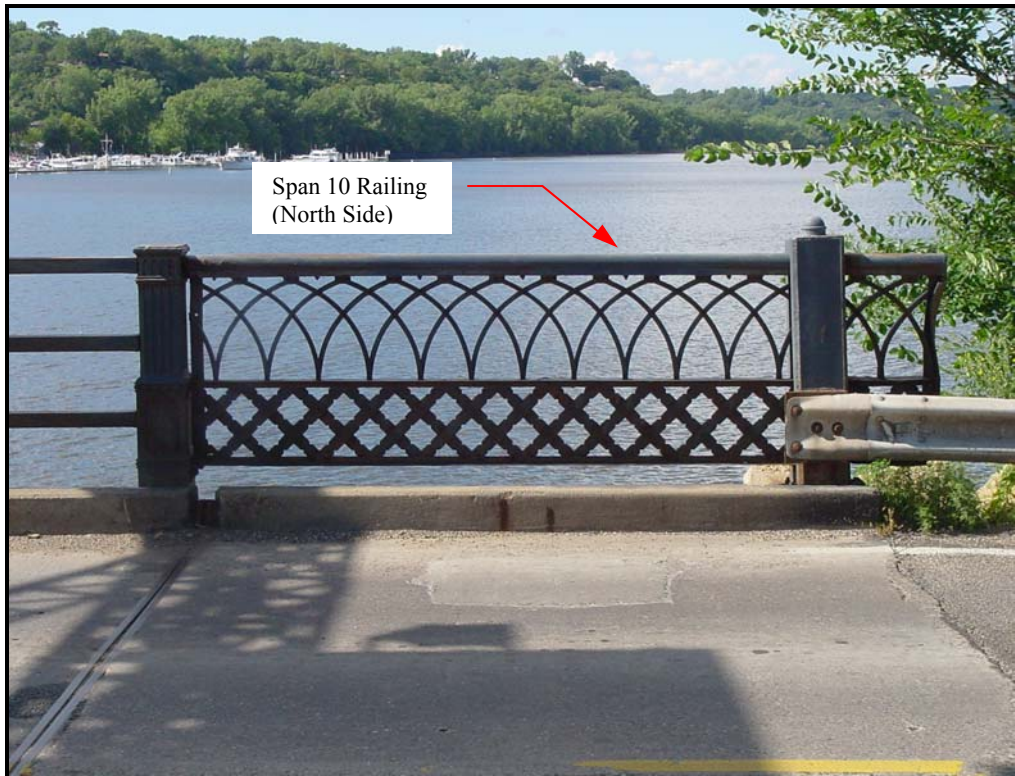


Photo 6: North Side Span 10 Railing



Photo 7: Typical Retrofit of Newel Post Light Anchorage



Photo 8: Newel Post Hand-hole – Missing Cover Plate



Photo 9: Span 10 Modified Newel Post



Photo 10: General Corrosion of Original Railing Cross-bar Pane



Photo 11: Corrosion of Original Railing Cross-Bars



Photo 12: Corrosion of Original Railing Cross-Bars



Photo 13: Substantial Section Loss to Rail Post Flanges Due to Corrosion



Photo 14: Broken Newel Post Anchorage Flange