Rehabilitation Case Studies: Lessons Learned and Suggested Solutions
Overview

- Rehabilitation examples by type and materials
- Load capacity
- Vertical clearance
- Width
- Railings
- ADA
- Construction
- Panel discussion of challenges and solutions
Cappelen Memorial Bridge, Minneapolis MN
Cappelen Memorial Bridge, Minneapolis MN

Age of Bridge Fabric
Cappelen Memorial Bridge, Minneapolis MN

1970s rehabilitation

- Altered observation bays on river piers
- Altered cap beam ends
- "Entablature" with faceted blocks at "frieze" level removed
- Curved cap beam ends
- West bank pier (pier 1)
Proposed east and west widening (looking west)

Pier 3 and Span 4
Cappelen Memorial Bridge, Minneapolis MN

1923 CONFIGURATION

1970 CONFIGURATION

PROPOSED CONFIGURATION

NOTES:
2020 — PROPOSED CHANGES INCLUDES:
A. NEW DECK 
B. NEW RAILING
C. NEW SPANISH GIRDERS
D. NEW CAP BEAMS
2010 — PROPOSED CHANGES INCLUDES
A. NEW DECK GIRDERS AT EAST END
B. NEW RAILING
C. NEW CAP BEAMS
D. DETAILING DETAILING AT TOP OF NEW BEAMS
Como Park Footbridge, St. Paul MN

- 1904: Pedestrian grade-separation bridge opens
- 1954: End of streetcar service
- 1960s Vandalism
“A detail that calls for special notice . . . is the plaster and lath lining of the forms at all places where the finished concrete would be exposed to view. The drawing Fig. 3 shows the nature of this lining and also the form for the cornice molding of the edge of the floor slab.”

“After the forms were removed, the entire surface of the bridge was painted two coats of 2:1 cement and plaster of paris”


“The bridge was built of 1-2-4 concrete with a 1-2 mortar facing on all exposed surfaces.”

Fig. 3. Detail of Cornice Form and Lath and Plaster Form Lining, Como Park Foot-Bridge.
Como Park Footbridge, St. Paul MN

Parge coat: historic
Parge coat: rehab options
Como Park Footbridge, St. Paul MN
Como Park Footbridge, St. Paul MN
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Como Park Footbridge, St. Paul MN
Como Park Footbridge, St. Paul MN
Como Park Footbridge, St. Paul MN
Como Park Footbridge, St. Paul MN
Como Park Footbridge, St. Paul MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN

Buckled gusset plate between diagonal & vertical members
# Holmes Street Bridge, Shakopee MN

## Concrete Repair Table

<table>
<thead>
<tr>
<th>Item/Location</th>
<th>Historic Restoration Type 1</th>
<th>Historic Restoration Type 2</th>
<th>MnDOT standard repair w/o coating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parapet railing above deck</td>
<td>X</td>
<td></td>
<td></td>
<td>Graffiti removed</td>
</tr>
<tr>
<td>Abutment side walls, south and north abutments</td>
<td>X</td>
<td></td>
<td></td>
<td>Graffiti removed</td>
</tr>
<tr>
<td>Abutment face, south abutment</td>
<td>X</td>
<td></td>
<td></td>
<td>Graffiti removed</td>
</tr>
<tr>
<td>Abutment face, north abutment</td>
<td></td>
<td>X</td>
<td></td>
<td>To accommodate graffiti paint-over</td>
</tr>
<tr>
<td>South and north approach spans</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piers 1, 6 &amp; 7 and land face of pier 2</td>
<td></td>
<td>X</td>
<td></td>
<td>To accommodate graffiti paint-over</td>
</tr>
<tr>
<td>River piers (3-4-5) and river face of pier 2</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>North stairways</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Holmes Street Bridge, Shakopee MN
Old Cedar Avenue Bridge, Bloomington MN

- 1920: Bridge opens
- By 1923: Problems
Old Cedar Avenue Bridge, Bloomington MN

- 1993: Closed to vehicular traffic
- 2002: Closed to any use
- 2015: Rehabilitation begins
Old Cedar Avenue Bridge, Bloomington MN

Concrete
Old Cedar Avenue Bridge, Bloomington MN

Concrete
Old Cedar Avenue Bridge, Bloomington MN

Rivets: 1: hex nut; 2: cap cover; 3: hex head; 4. buttonhead
Old Cedar Avenue Bridge, Bloomington MN

Rivets
Old Cedar Avenue Bridge, Bloomington MN

Gusset plates
Paint

1919-1920 Drawings:
Shop paint one coat pure red lead and boiled linseed oil.
Field paint one coat graphite. Industrial gray color.

1958 Bridge blasted and repainted (red lead, black, and aluminum paint).
Old Cedar Avenue Bridge, Bloomington MN
Duluth Aerial Lift Bridge, Duluth MN
Duluth Aerial Lift Bridge, Duluth MN
Duluth Aerial Lift Bridge, Duluth MN
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Duluth Aerial Lift Bridge, Duluth MN
Steel Bridge, longest single Span in the U. S.,
Waco, Texas.
Washington Avenue Bridge, Waco TX
Washington Avenue Bridge, Waco TX
TARGET RATING: HS 20, Operating

C/L Span

U8 U6 U4
M3 M5 M7

SUB-TIES ~ HS 3
ALL OTHERS > HS 20

Washington Avenue Bridge, Waco TX
Replace all sub-tie eyebars
Washington Avenue Bridge, Waco TX
Washington Avenue Bridge, Waco TX
Washington Avenue Bridge, Waco TX
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Judge Seeber Vertical Lift Bridge, Orleans Parish LA
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
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Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN
Gateway Trail Iron Bridge, MN

- [http://www.youtube.com/watch?v=ywpNKMbFqG0](http://www.youtube.com/watch?v=ywpNKMbFqG0)
Gateway Trail Iron Bridge, MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
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Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
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Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Roosevelt Bridge, Austin MN
Stewart Creek Bridge, Duluth MN
Stewart Creek Bridge, Duluth MN
Stewart Creek Bridge, Duluth MN
Stewart Creek Bridge, Duluth MN
Stewart Creek Bridge, Duluth MN

07/17/2013

07/19/2013

07/23/2013
Stewart Creek Bridge, Duluth MN
Stewart Creek Bridge, Duluth MN
Load Capacity – Bridge 3355, Whitefish Creek MN
Load Capacity – Bridge 3355, Whitefish Creek MN
Load Capacity – Bridge 3355, Whitefish Creek MN
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Load Capacity – Bridge 3355, Whitefish Creek MN

PROPOSED SECTION THROUGH ARCH – INDEPENDENT SLAB OPTION

SCALE: 0  2'-8"
Load Capacity – Broadway Bridge, St. Peter MN
Load Capacity – Broadway Bridge, St. Peter MN

Figure 13 - Deterioration of Components NE Bridge Corner

Figure 6 - Truss Details at the Pier
Load Capacity – Broadway Bridge, St. Peter MN
Load Capacity – Broadway Bridge, St. Peter MN

2009 Inventory Form

<table>
<thead>
<tr>
<th>+ CAPACITY RATINGS +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Load</td>
</tr>
<tr>
<td>Operating Rating</td>
</tr>
<tr>
<td>Inventory Rating</td>
</tr>
<tr>
<td>Posting</td>
</tr>
<tr>
<td>Rating Date</td>
</tr>
</tbody>
</table>

Mn/DOT Permit Codes

A: 1  B: 3  C: 3

2014 Plans

FEDERAL PROJ. NO. STMP4013 (227)

DESIGN DATA

2012 AND CURRENT INTERIM AASHTO LRFD
BRIDGE DESIGN SPECIFICATIONS
LOAD AND RESISTANCE FACTOR DESIGN METHOD
HL 93 LIVE LOAD

MATERIAL DESIGN PROPERTIES:
REINFORCED CONCRETE:
\[ f'c = 4 \text{ ksi} \quad n = 8 \]
\[ F_y = 60 \text{ ksi} \quad \text{FOR REINFORCEMENT} \]

STRUCTURAL STEEL:
\[ F_y = 50 \text{ ksi} \]
STRUCTURAL STEEL SPEC. 3309

DECK AREA = 15,457 SQ. FT.
DESIGN SPEED = 30 MILES PER HOUR
BRIDGE OPERATING RATING HS 38.6
Load Capacity – 15th-16th Streets, Minneapolis MN
Load Capacity – 15th-16th Streets, Minneapolis MN
Load Capacity – 15th-16th Streets, Minneapolis MN
Load Capacity – 15th-16th Streets, Minneapolis MN
Load Capacity – 15th-16th Streets, Minneapolis MN

[Image of a construction site under a bridge with excavation work and safety barriers.]
Load Capacity – 15th-16th Streets, Minneapolis MN
Load Capacity – 15th-16th Streets, Minneapolis MN

- [insert video clip of issues and repair strategies]
Vertical Clearance – Bridge 9053, Bloomington MN
Vertical Clearance – Bridge 9053, Bloomington MN
Width – Carrollton Bridge, Carroll Co. IN
Width – Carrollton Bridge, Carroll Co. IN
Width – Carrollton Bridge, Carroll Co. IN

05/16/2005
Width – Carrollton Bridge, Carroll Co. IN
Width – Carrollton Bridge, Carroll Co. IN
Railings – Lester River Bridge, Duluth MN
Railings – Lester River Bridge, Duluth MN
Railings – Lester River Bridge, Duluth MN
Railings – Bridge 3355, Whitefish Creek MN
Railings – Bridge 3355, Whitefish Creek MN
Railings – Bridge 3355, Whitefish Creek MN
Railings – Bridge 3355, Whitefish Creek MN
Railings – Bridge 5265, Garrison MN
Railings – Bridge 5265, Garrison MN
Railings – Bridge 5265, Garrison MN
Railings - Bridge 5265, Garrison, MN
Railings – Bridge 5265, Garrison MN

2”
Railings – Bridge 5265, Garrison MN

3”
Railings – Bridge 5265, Garrison MN

6”
Railings – Robert A. Booth Bridge, Winchester OR
Railings – Robert A. Booth Bridge, Winchester OR

36-inch rail

42-inch rail
Railings – Robert A. Booth Bridge, Winchester OR
Railings – Robert A. Booth Bridge, Winchester OR
Railings – Bridge 6679, Houston Co. MN
Railings – Bridge 6679, Houston Co. MN
Railings – Bridge 6679, Houston Co. MN

Original Railing

TL-4
Railings – Bridge 6679, Houston Co. MN
Railings – Bridge 6679, Houston Co. MN

- Solution: Design exception to use TL-3 standard
Railings – Bridge 6679, Houston Co. MN

Before

After
Railings – Bridge 6679, Houston Co. MN

Railing mock up

Stain testing
Railings – Bridge 6679, Houston Co. MN

After
Railings – Bridge 9395, Beaver Bay MN
Railings – Bridge 9395, Beaver Bay MN
Railings – Holmes Street Bridge, Shakopee MN

Stainless steel cable

Plans by HDR Engineering, Inc.
Railings – Holmes Street Bridge, Shakopee MN
Railings – Bridge 5388, MN

Before

After
Railings – Phelps Mill Bridge, Otter Tail Co. MN

Before

After
Railings – Stillwater Lift Bridge, Stillwater MN
Railings – Swayback Bridge, Redwood Falls MN
Railings – Swayback Bridge, Redwood Falls MN
Railings – Swayback Bridge, Redwood Falls MN
ADA – Holmes Street Bridge, Shakopee MN
ADA – Holmes Street Bridge, Shakopee MN
ADA – Holmes Street Bridge, Shakopee MN
ADA – Stillwater Lift Bridge, Stillwater MN

- https://www.youtube.com/watch?feature=player_embedded&v=n6yKHJunqKI
ADA – Stillwater Lift Bridge, Stillwater MN
Construction – Phalen Park Arch Bridge, St. Paul MN
• [insert video clip]
Questions and Panel Discussion