Rehabilitation Case Studies: Lessons Learned and Suggested Solutions

Overview

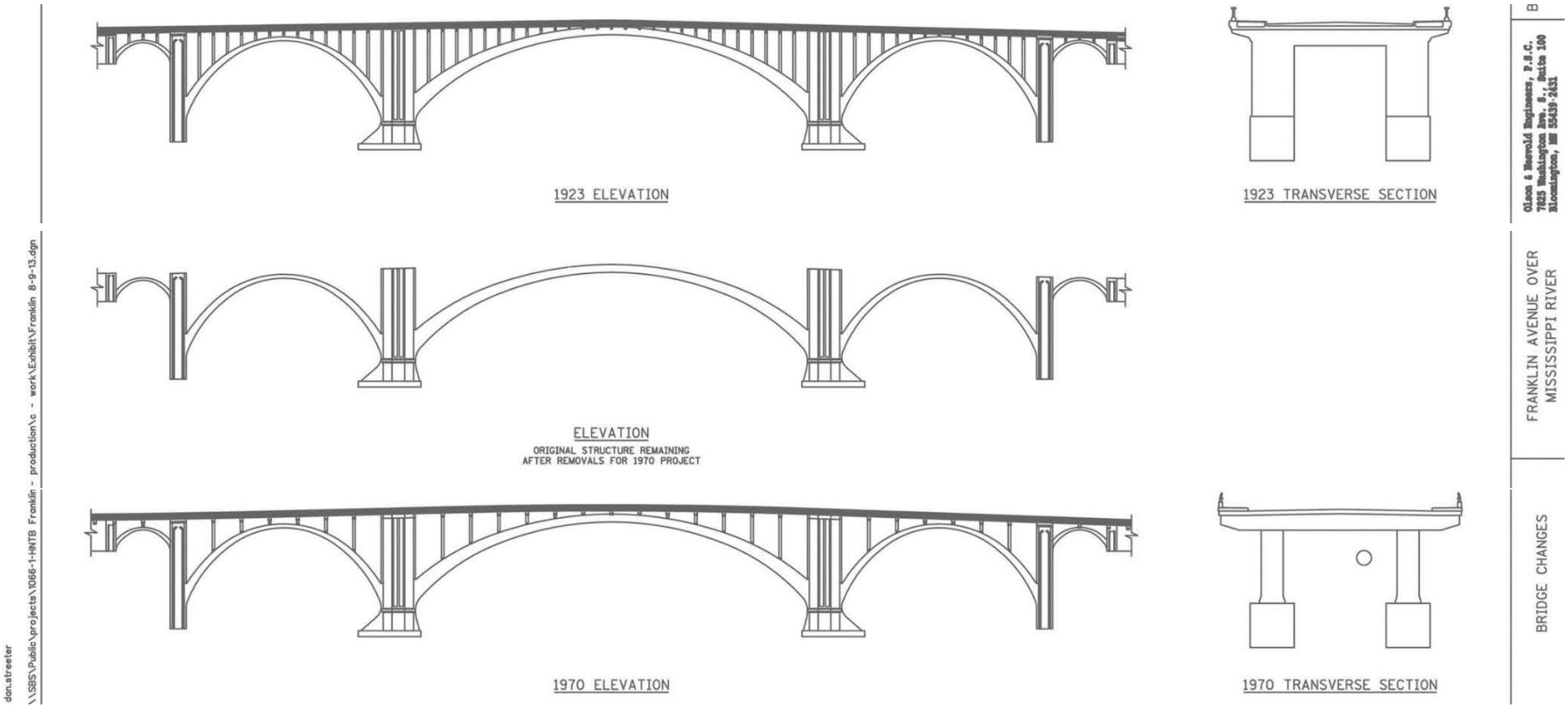
- **Rehabilitation examples by type and materials**
- **Load capacity**
- **Vertical clearance**
- **Width**
- **Railings**
- **ADA**
- **Construction**
- **Panel discussion of challenges and solutions**

Cappelen Memorial Bridge, Minneapolis MN

Cappelen Memorial Bridge, Minneapolis MN

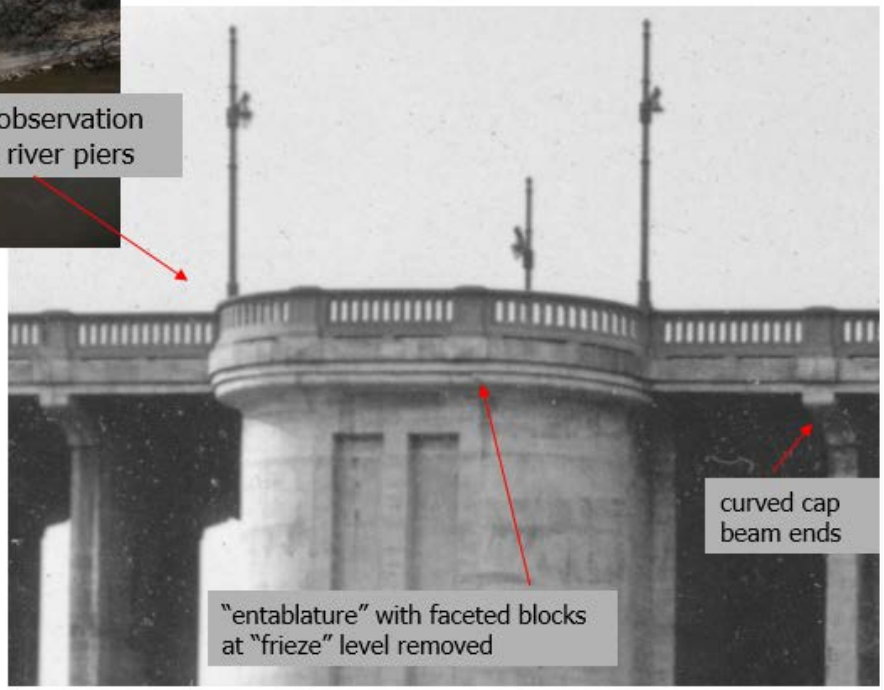
Cappelen Memorial Bridge, Minneapolis MN

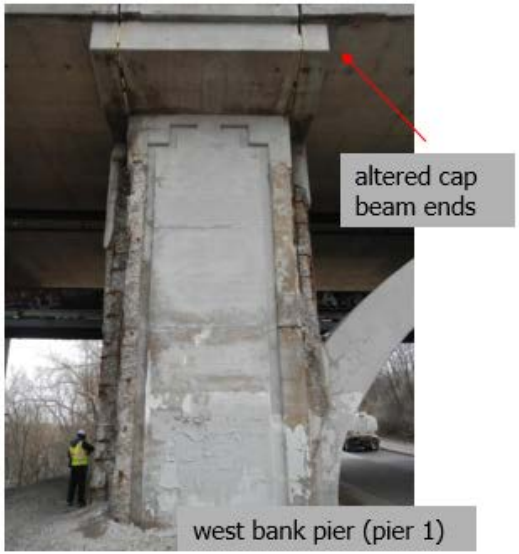
Age of Bridge Fabric



Cappelen Memorial Bridge, Minneapolis MN

1970s rehabilitation



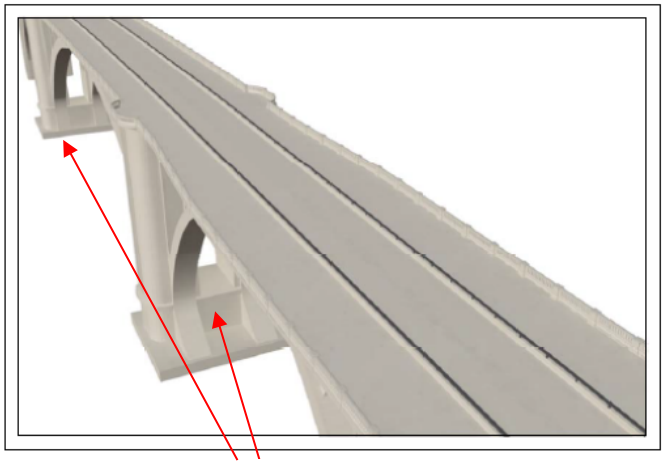


Cappelen Memorial Bridge, Minneapolis MN

Proposed east and west widening (looking west)

1923 CONFIGURATION

PROPOSED CONFIGURATION



Pier 3 and Span 4

1970 CONFIGURATION

Cappelen Memorial Bridge, Minneapolis MN

1923 CONFIGURATION

PROPOSED CONFIGURATION

1970 CONFIGURATION

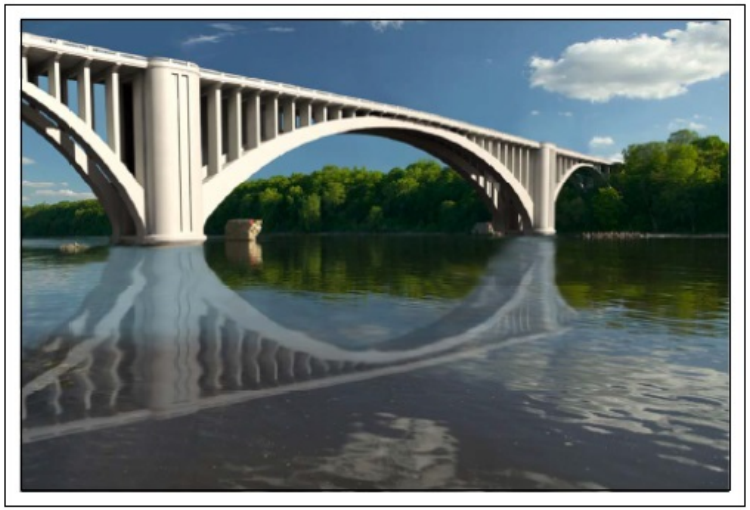
NOTES:

1923 → 1970 CHANGES INCLUDE:
- A. NEW WIDER DECK
- B. NEW RAILING
- C. NEW SPANDREL COLUMNS
- D. NEW CAP BEAMS

1970 → PROPOSED CHANGES INCLUDE:
- E. NEW DECK (WIDER AT EAST END)
- F. NEW RAILING
- G. NEW CAP BEAMS
- H. ENTABLATURE DETAILING AT TOP OF RIVER PIERS

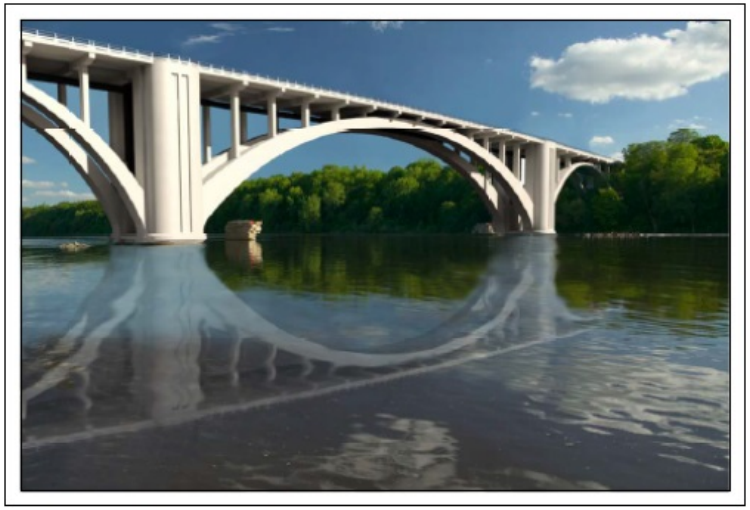
Cappelen Memorial Bridge, Minneapolis MN

1923 CONFIGURATION



PROPOSED CONFIGURATION

1970 CONFIGURATION



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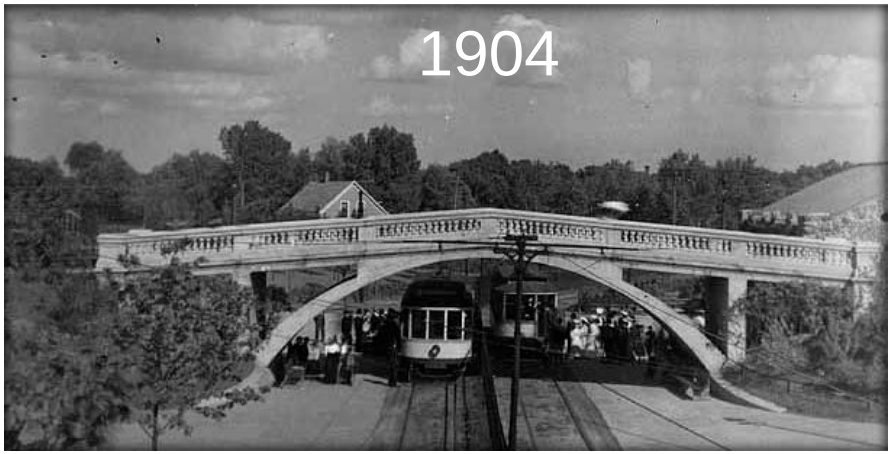
Como Park Footbridge, St. Paul MN

- **1904: Pedestrian grade-separation bridge opens**
- **1954: End of streetcar service**
- **1960s Vandalism**



Como Park Footbridge, St. Paul MN

“A detail that calls for special notice . . . is the plaster and lath lining of the forms at all places were 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”

“Reinforced Concrete Arch Bridges, Como Park, St. Paul,” *Engineering Record* 50 (December 1904): 648-649.

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

“A Reinforced Concrete Foot-Bridge at Como Park, St. Paul, Minn.,” *Engineering News* 53 (April 6, 1905): 352.

Como Park Footbridge, St. Paul MN

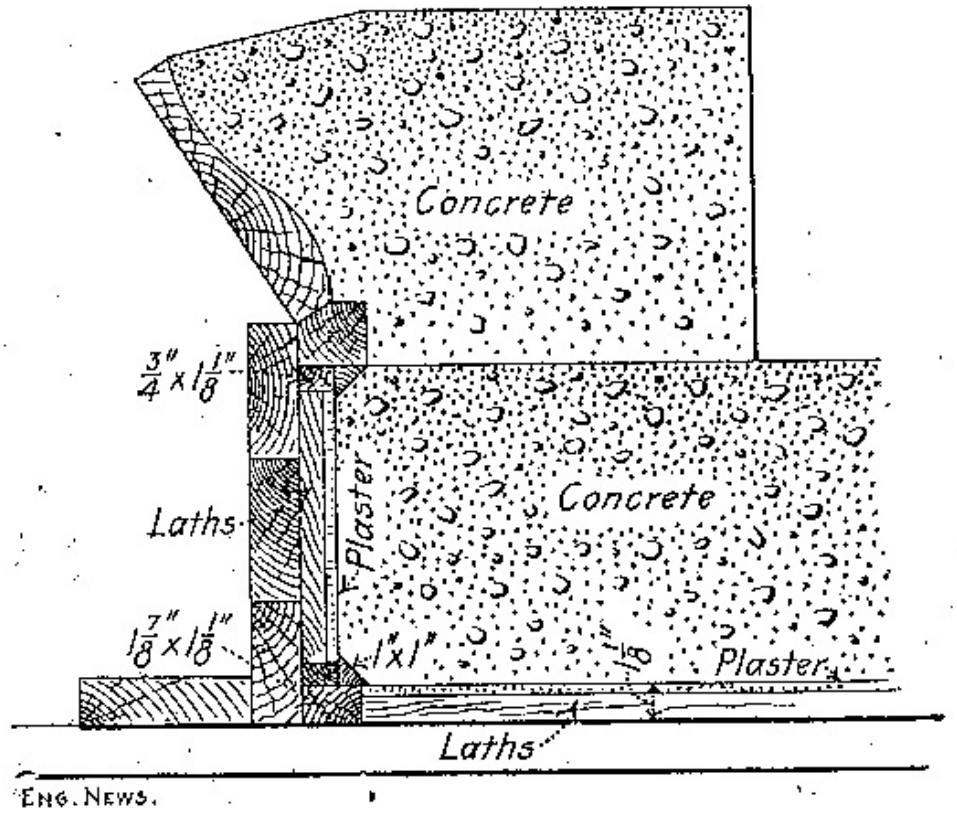


Fig. 3. Detail of Cornice Form and Lath and Plaster Form Lining, Como Park Foot-Bridge.

Como Park Footbridge, St. Paul MN

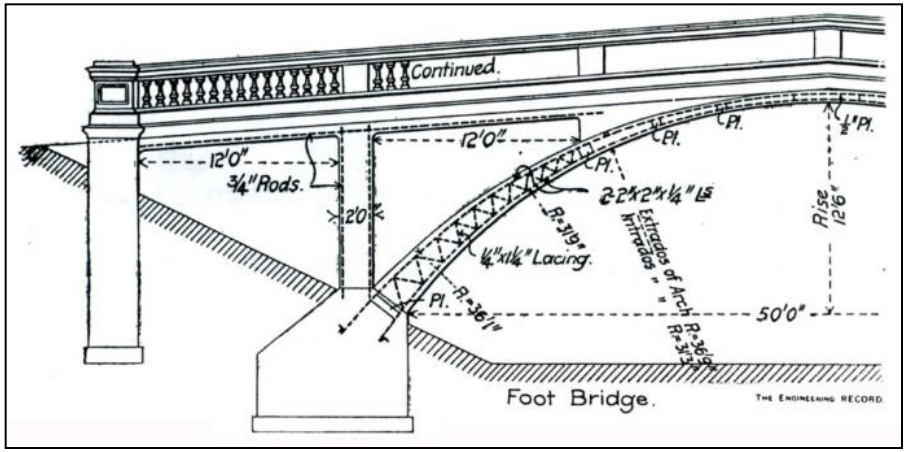
Parge coat: historic

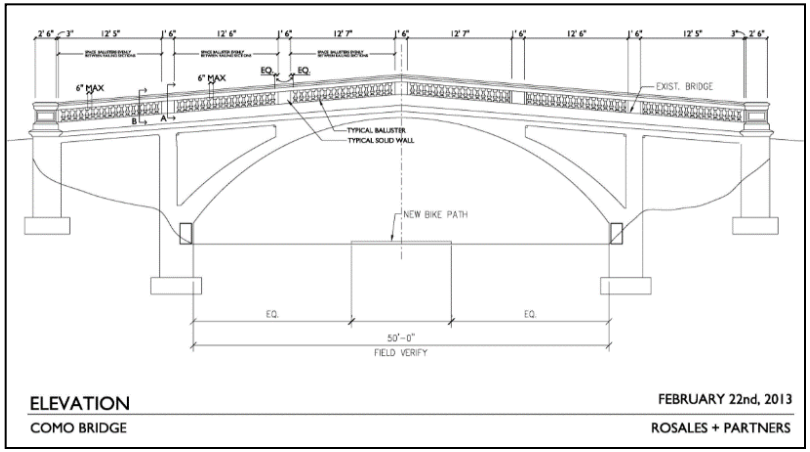
Como Park Footbridge, St. Paul MN

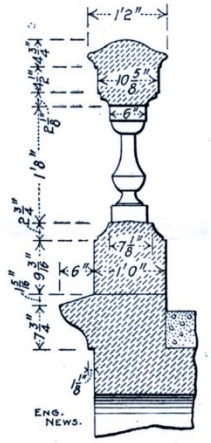
Parge coat: rehab options

Como Park Footbridge, St. Paul MN

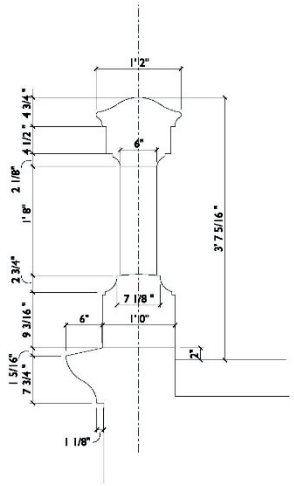
Como Park Footbridge, St. Paul MN



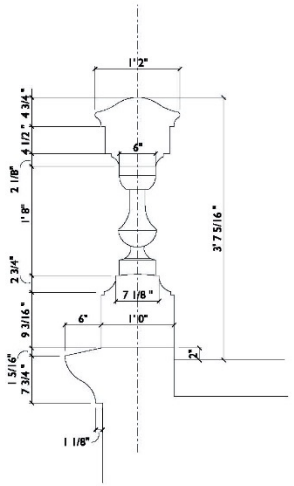




HISTORIC SECTION

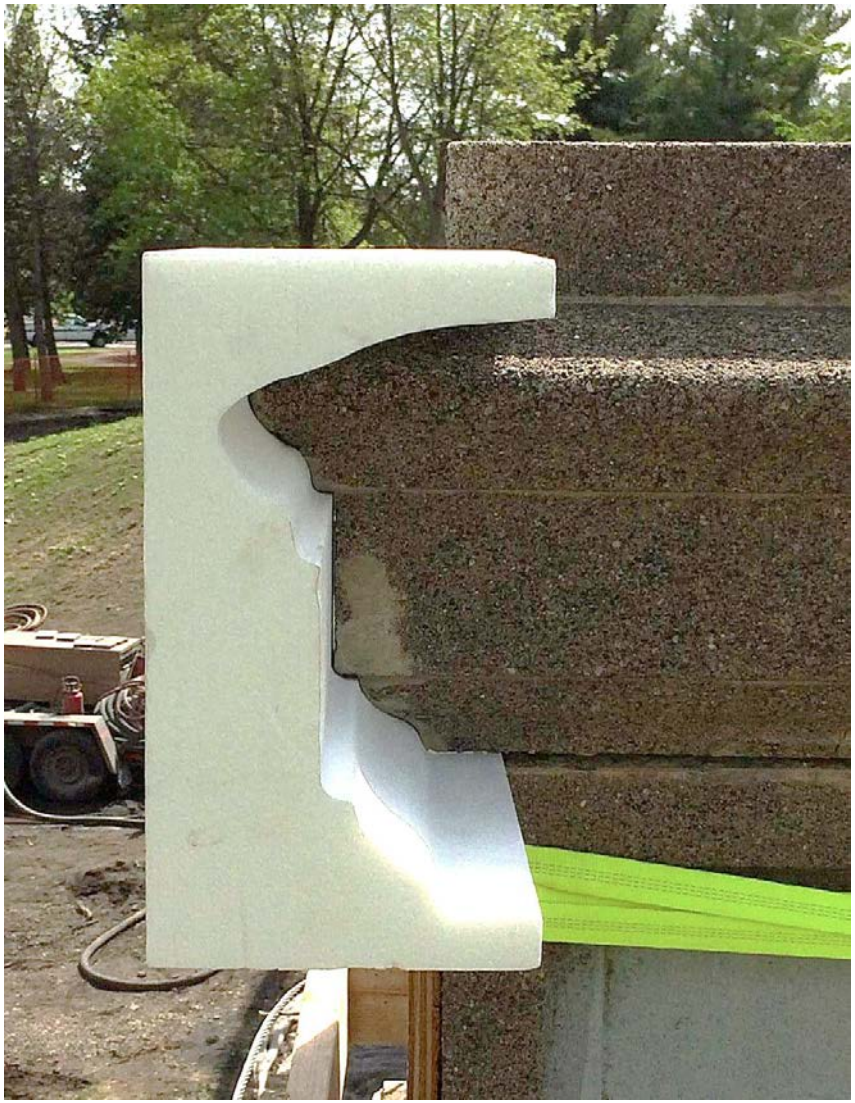


SECTION A - AT SOLID WALL



SECTION B - AT BALUSTER

Como Park Footbridge, St. Paul MN



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

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

4175 Concrete Repair Table				
Item/Location	Historic Restoration Type 1	Historic Restoration Type 2	MnDOT standard repair w/o coating	Comment
Parapet railing above deck	X			Graffiti removed
Abutment side walls, south and north abutments	X			Graffiti removed
Abutment face, south abutment	X			Graffiti removed
Abutment face, north abutment		X		To accommodate graffiti paint-over
South and north approach spans	X			
Piers 1, 6 & 7 and land face of pier 2		X		To accommodate graffiti paint-over
River piers (3-4-5) and river face of pier 2			X	
North stairways	X			

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

Holmes Street Bridge, Shakopee MN

Holmes Street Bridge, Shakopee MN

Old Cedar Avenue Bridge, Bloomington MN

- **1920: Bridge opens**
- **By 1923: Problems**

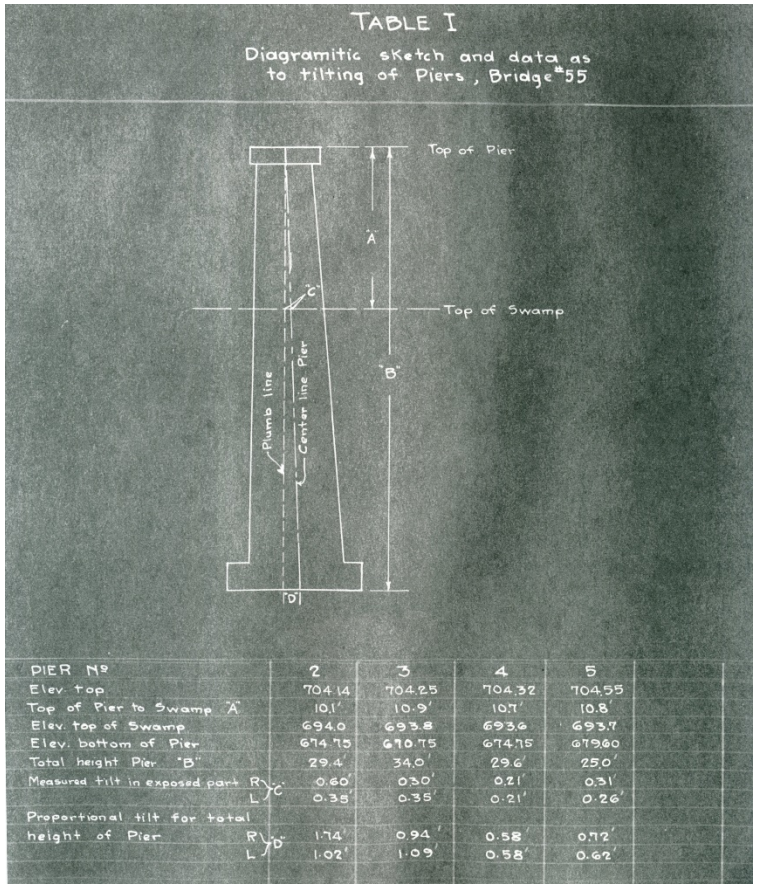


TABLE I

Diagramitic sKetch and data as to tilting of Piers, Bridge #55

PIER Nº	2	3	4	5
Elev. top	704.14	704.25	704.32	704.55
Top of Pier to Swamp "A"	10.1'	10.9'	10.7'	10.8'
Elev. top of Swamp	694.0	693.8	693.6	693.7
Elev. bottom of Pier	674.75	670.75	674.75	@79.60
Total height Pier "B"	29.4'	34.0'	29.6'	25.0'
Measured tilt in exposed part R/C	0.60'	0.30'	0.21'	0.31'
L/C	0.38	0.35'	0.21'	0.26'
Proportional tilt for total height of Pier R/D	1.74'	0.94'	0.58'	0.72'
L/D	1.02'	1.09'	0.58'	0.62'

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

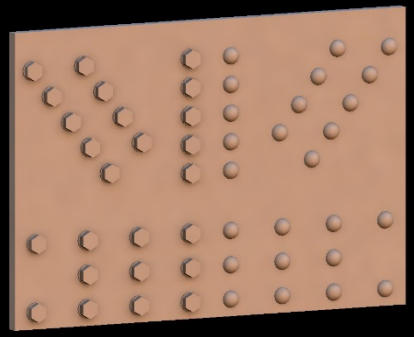
Old Cedar Avenue Bridge, Bloomington MN

Concrete

Old Cedar Avenue Bridge, Bloomington MN

Rivets: 1: hex nut; 2: cap cover; 3: hex head; 4. buttonhead

1



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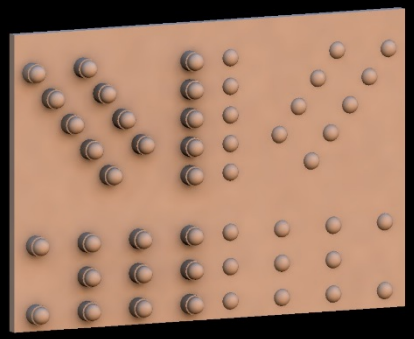

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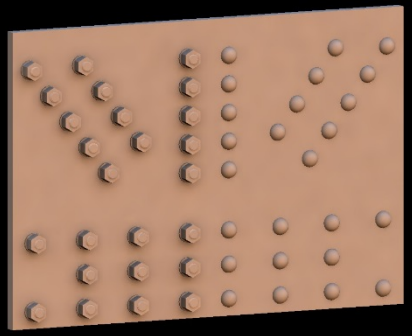

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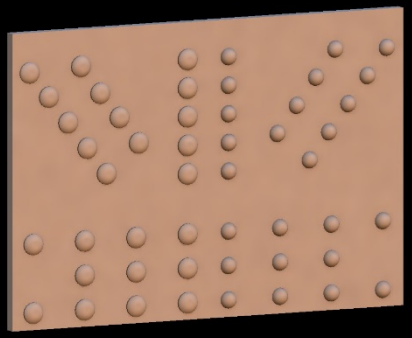
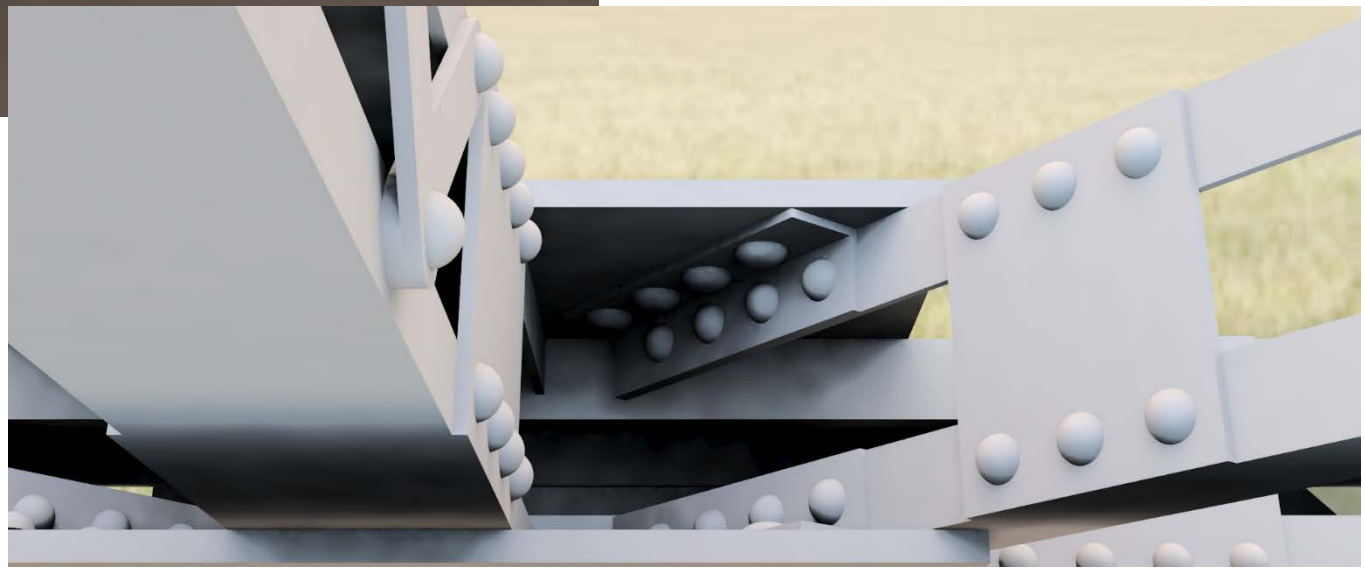
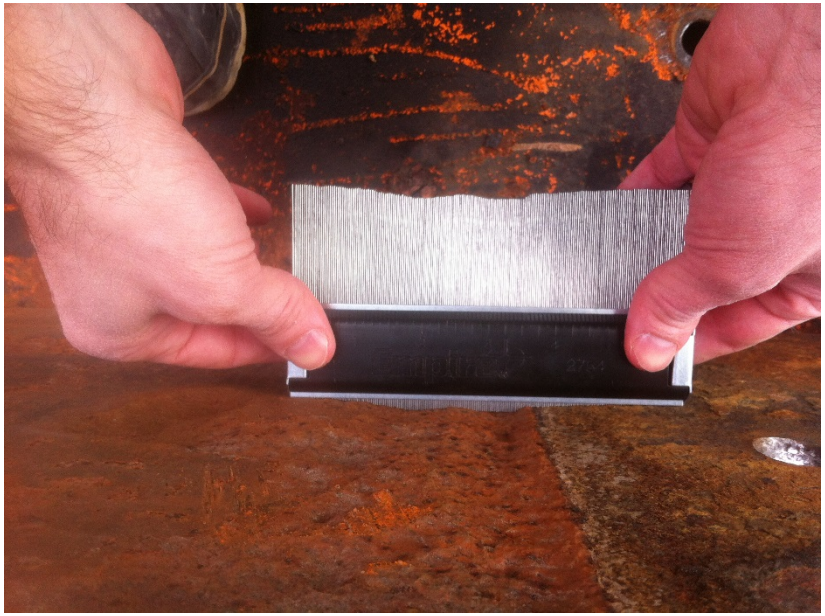


Old Cedar Avenue Bridge, Bloomington MN

Rivets



Old Cedar Avenue Bridge, Bloomington MN



Gusset plates

Old Cedar Avenue Bridge, Bloomington MN

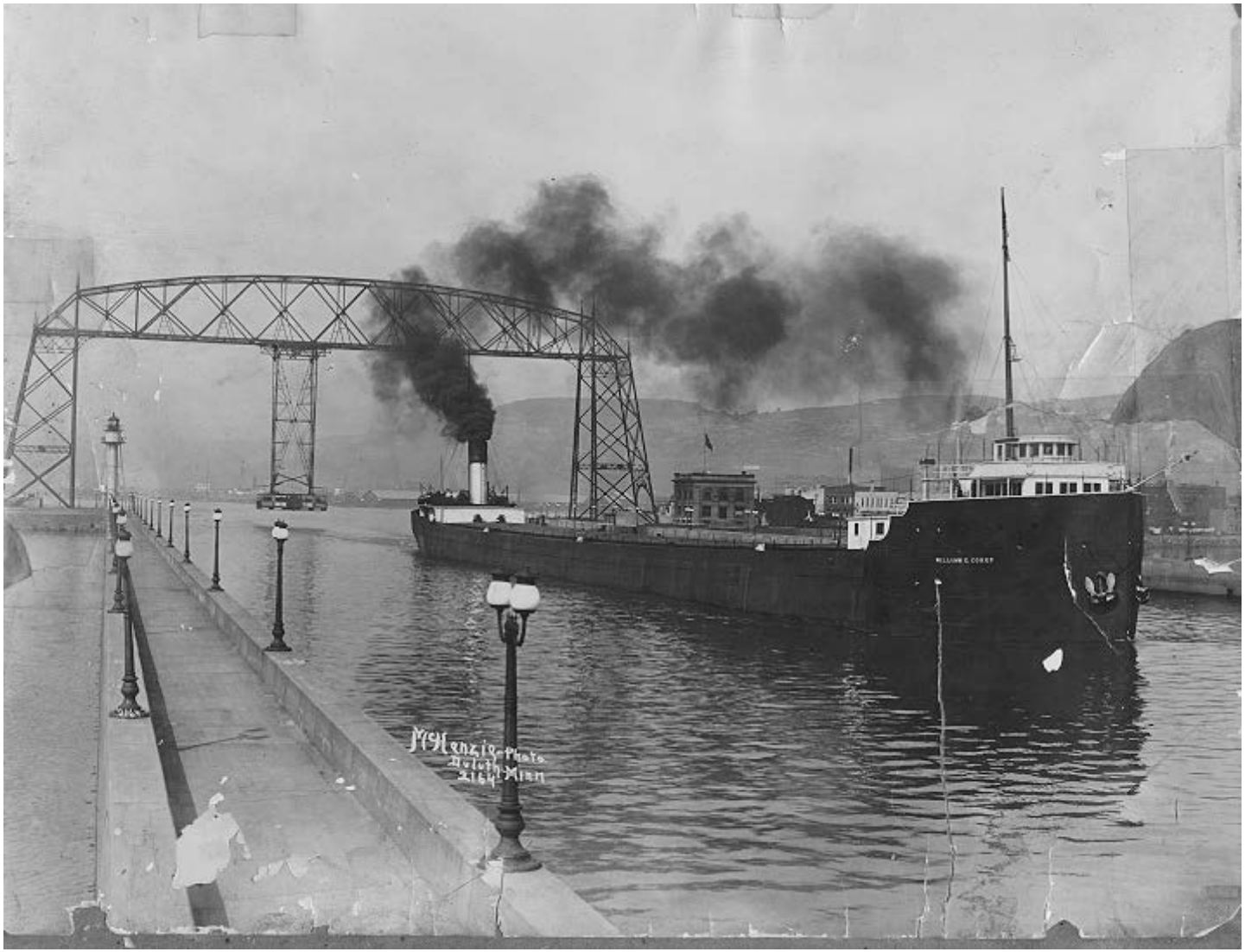
Paint

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

<u>1958</u> 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

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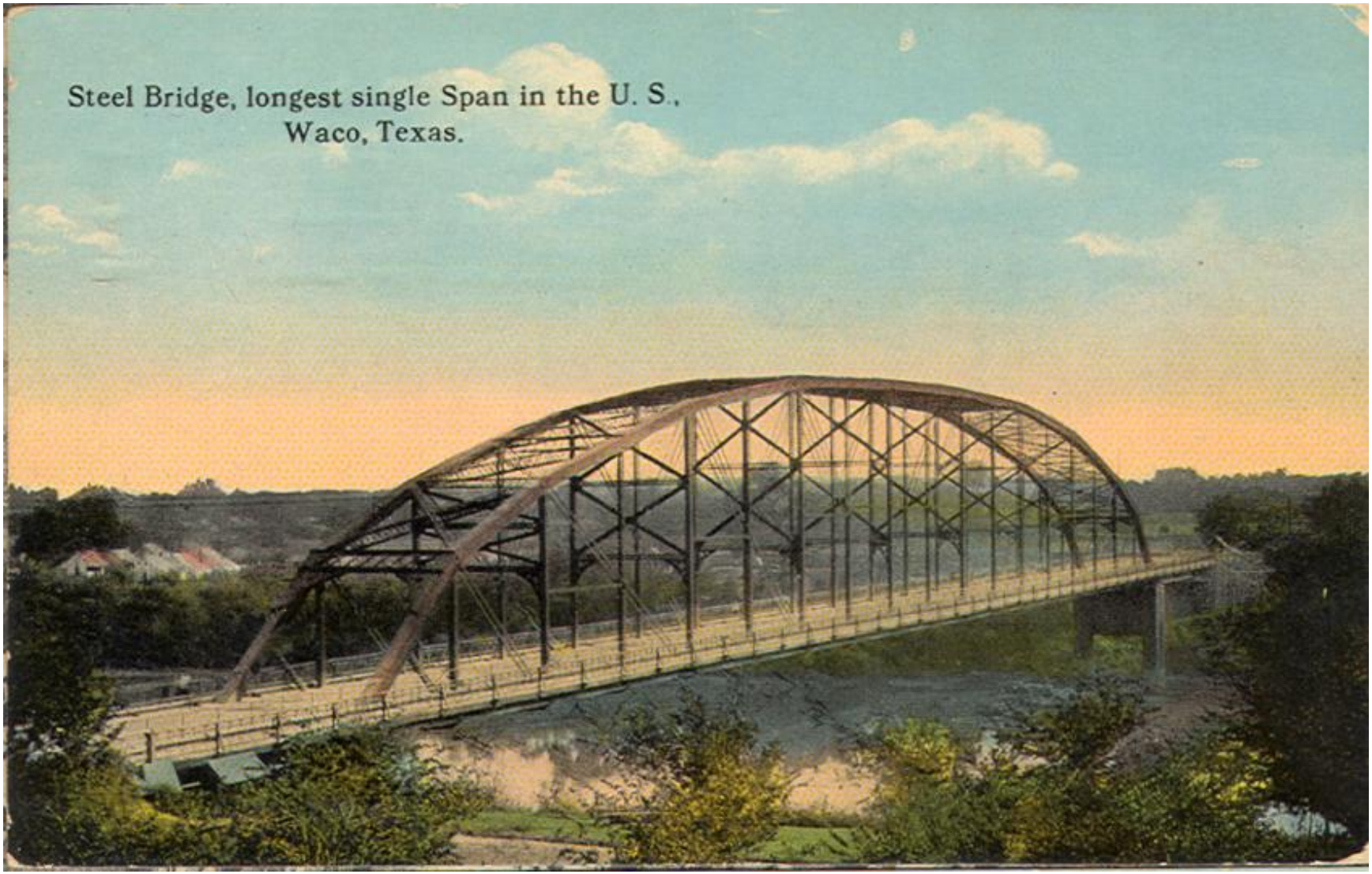
Duluth Aerial Lift Bridge, Duluth MN

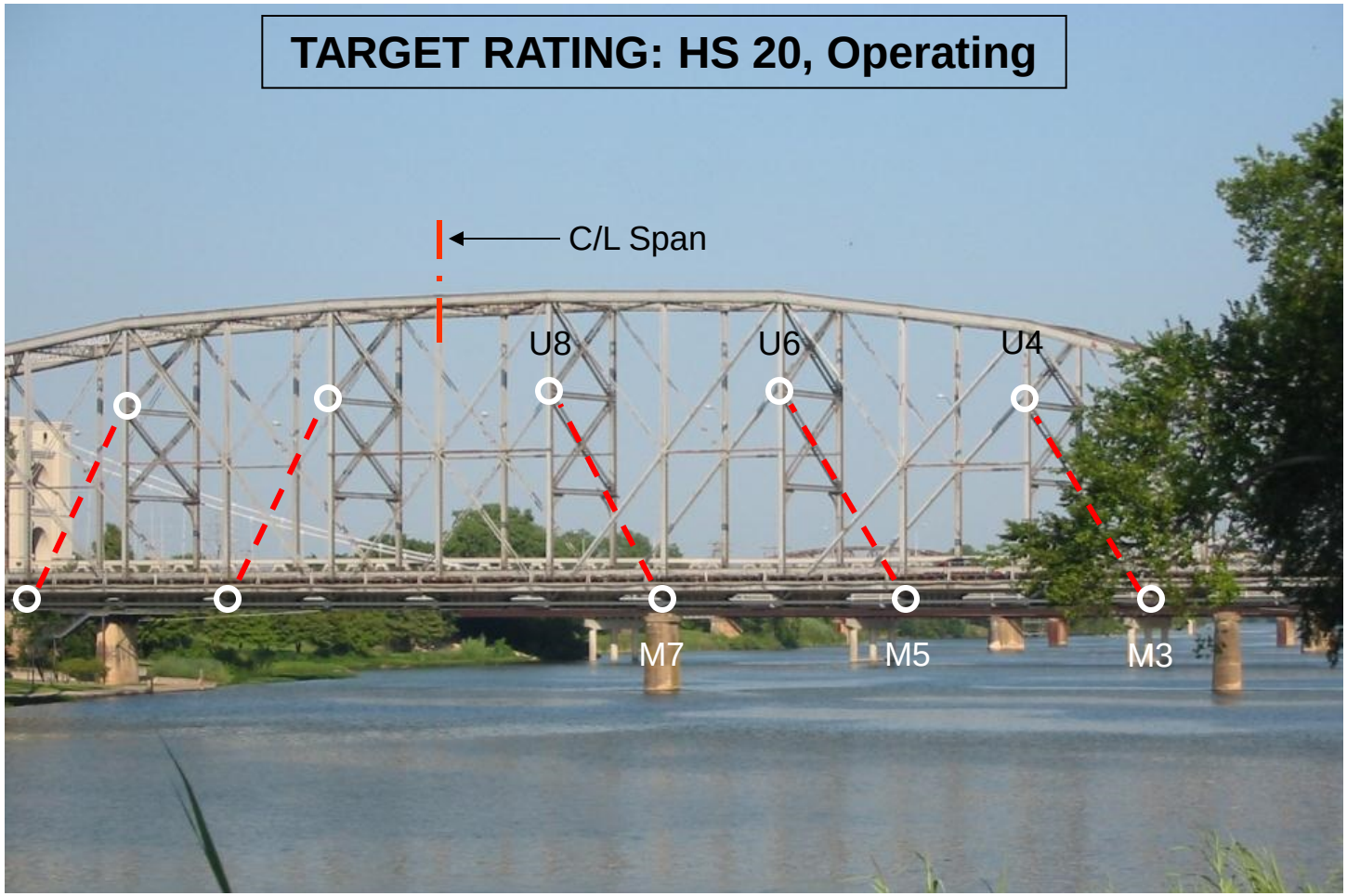
Washington Avenue Bridge, Waco TX



Washington Avenue Bridge, Waco TX

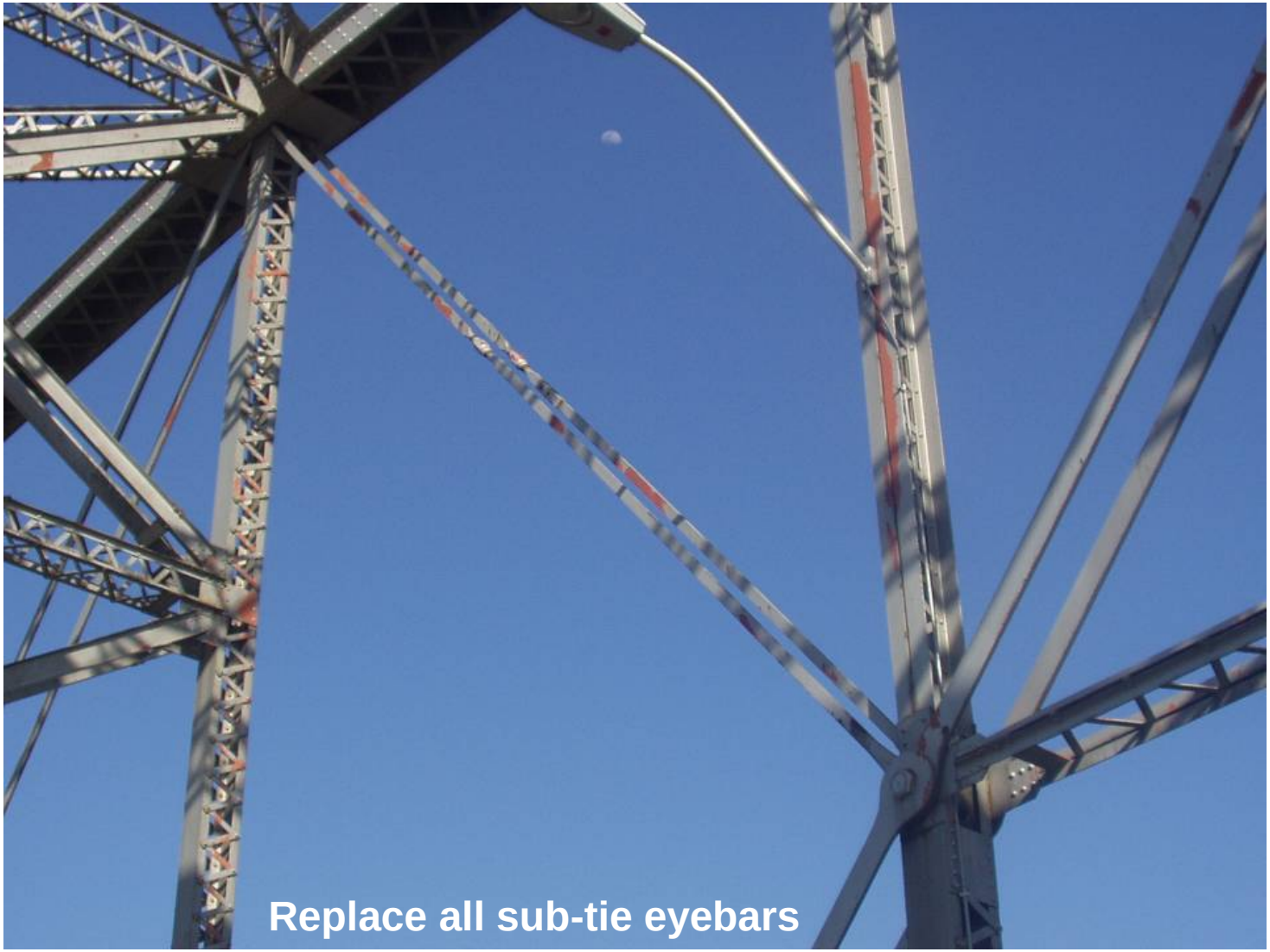
Washington Avenue Bridge, Waco TX

Washington Avenue Bridge, Waco TX



SUB-TIES ~ HS 3
ALL OTHERS > HS 20

Washington Avenue Bridge, Waco TX



Washington Avenue Bridge, Waco TX

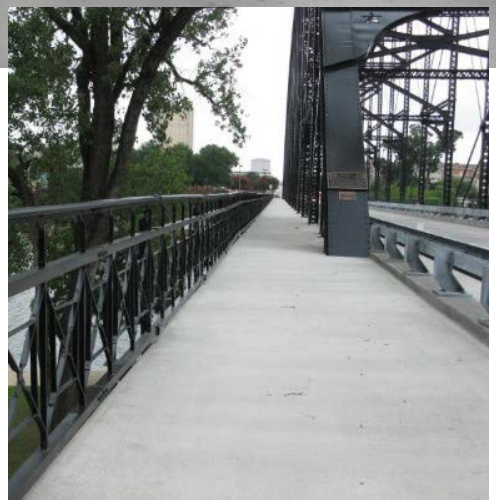
Washington Avenue Bridge, Waco TX

Washington Avenue Bridge, Waco TX

Washington Avenue Bridge, Waco TX

Washington Avenue Bridge, Waco TX

Before



After

Washington Avenue Bridge, Waco TX

Judge Seeber Vertical Lift Bridge, Orleans Parish LA

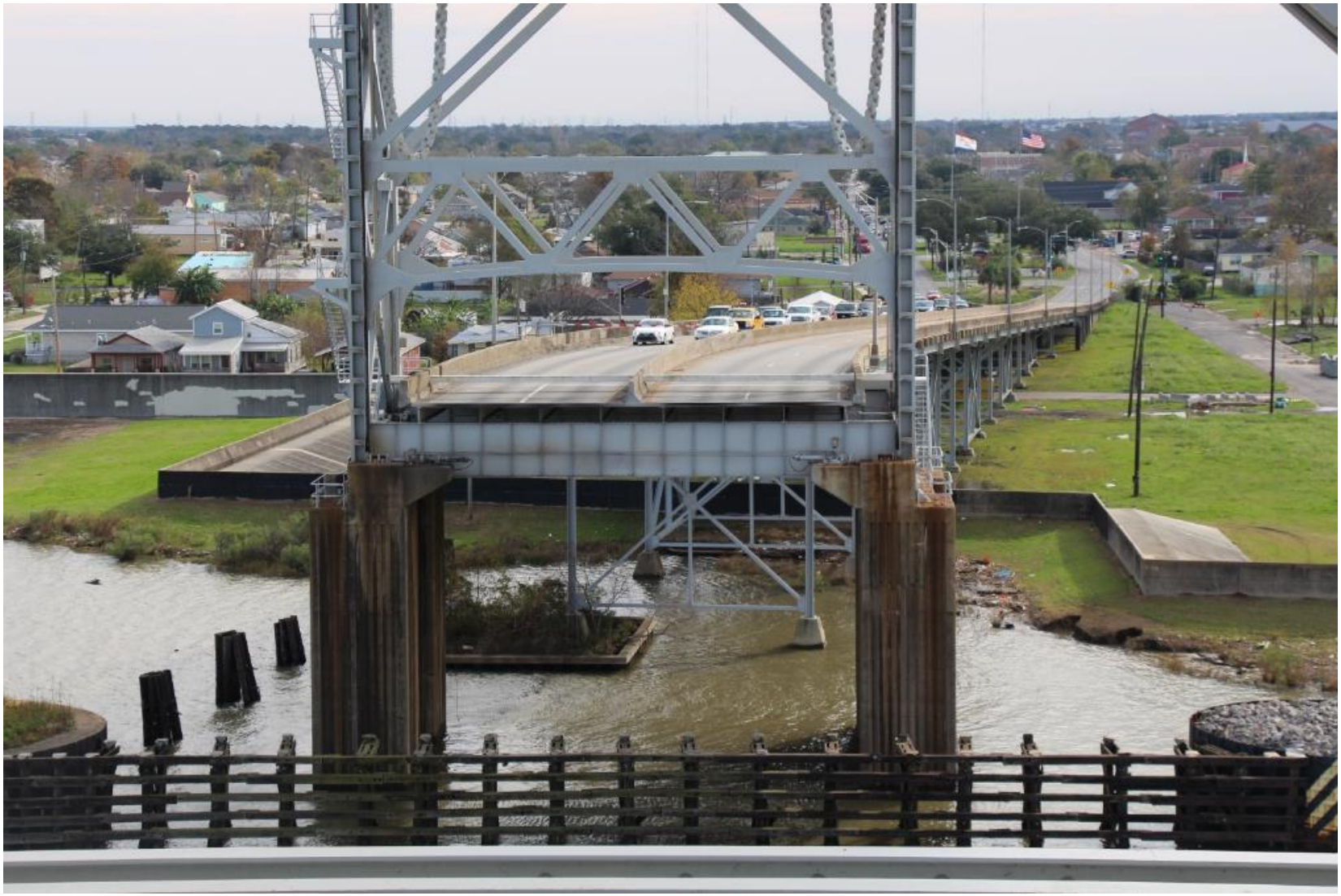
Judge Seeber Vertical Lift Bridge, Orleans Parish LA

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

Judge Seeber Vertical Lift Bridge, Orleans Parish LA

Gateway Trail Iron Bridge, MN

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

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

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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

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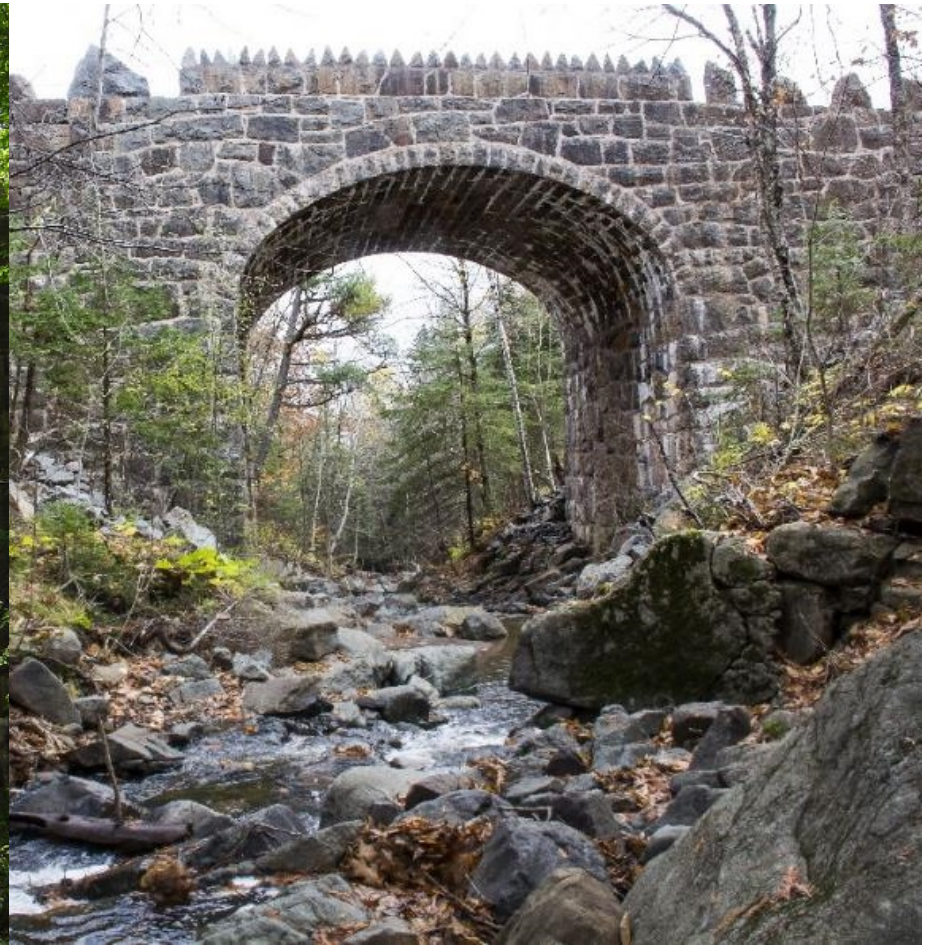
Stewart Creek Bridge, Duluth MN



Load Capacity – Bridge 3355, Whitefish Creek MN

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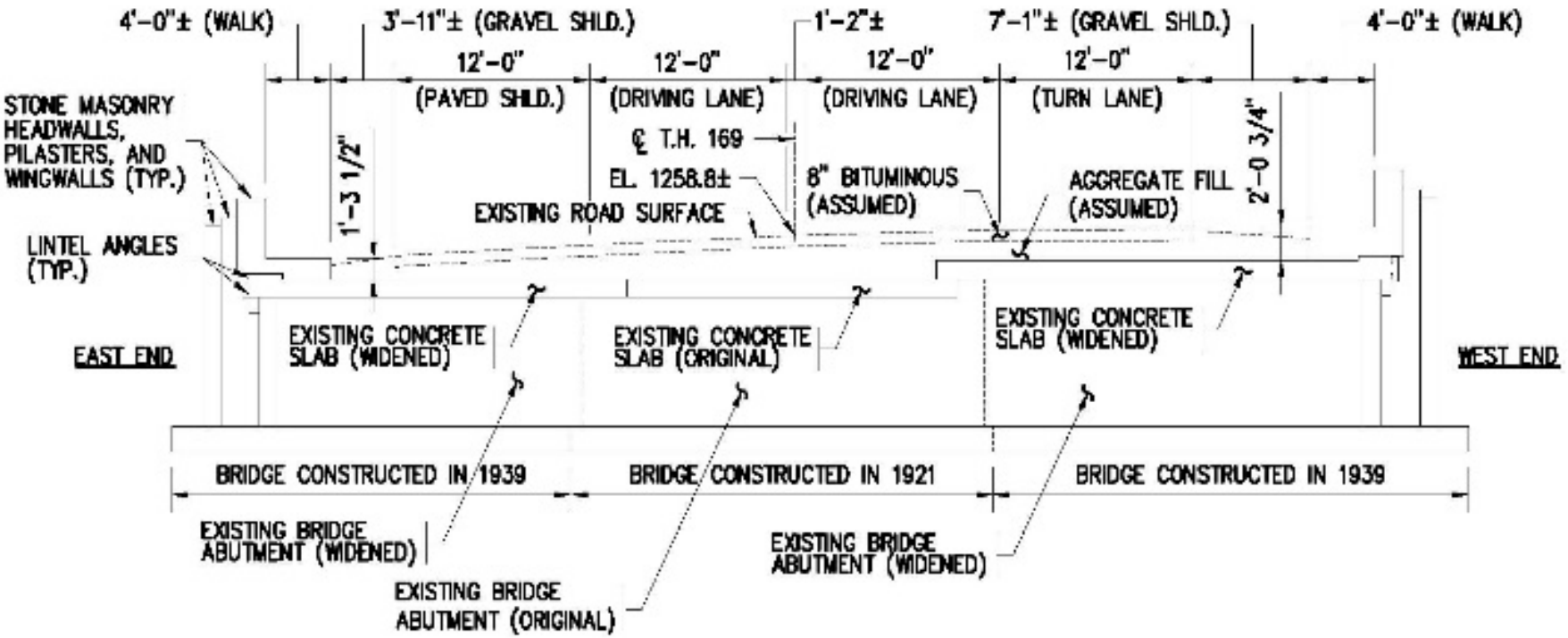
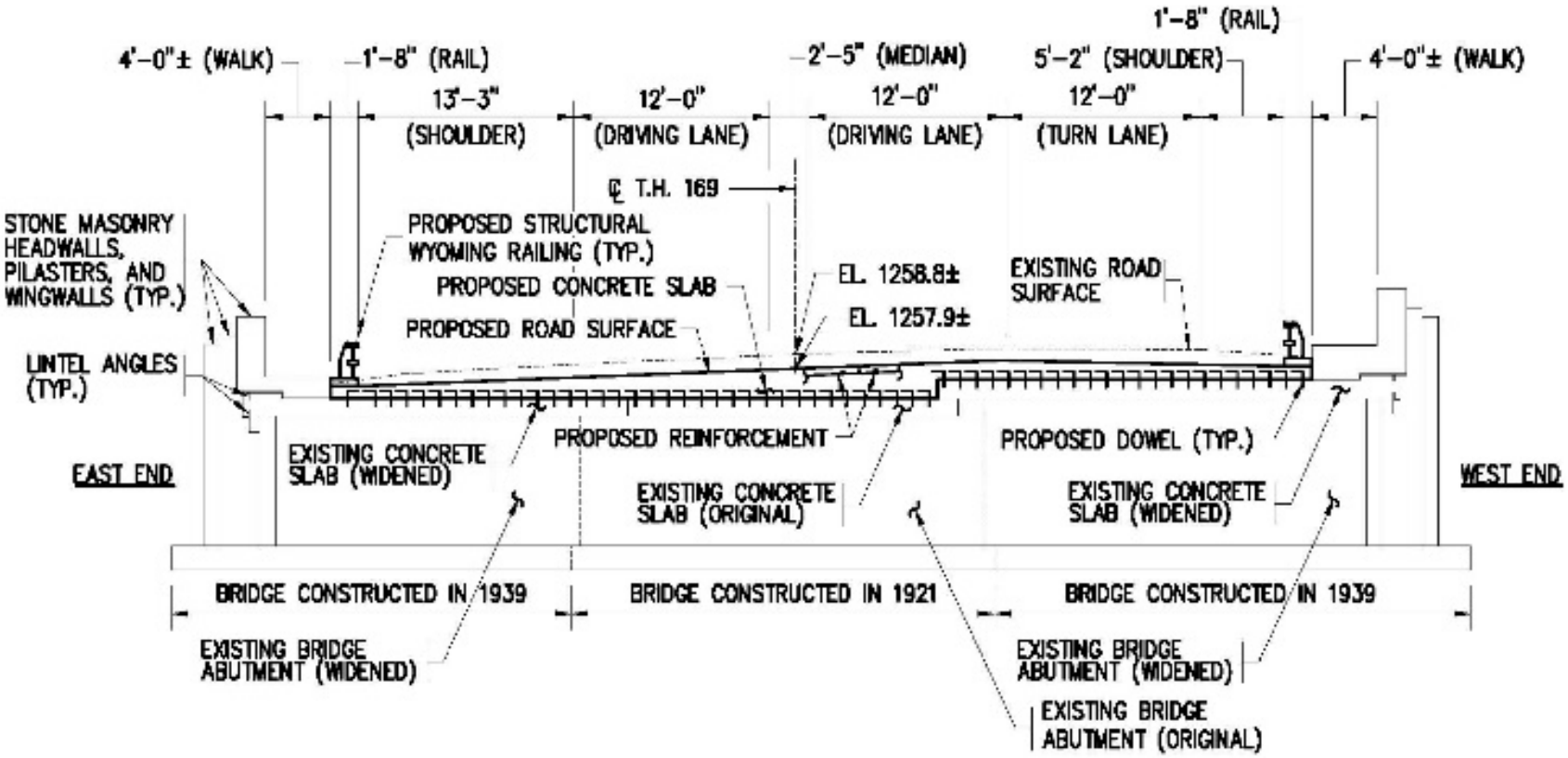


EXISTING SECTION THROUGH ARCH

SCALE: 0 2'-8"

Load Capacity – Bridge 3355, Whitefish Creek MN

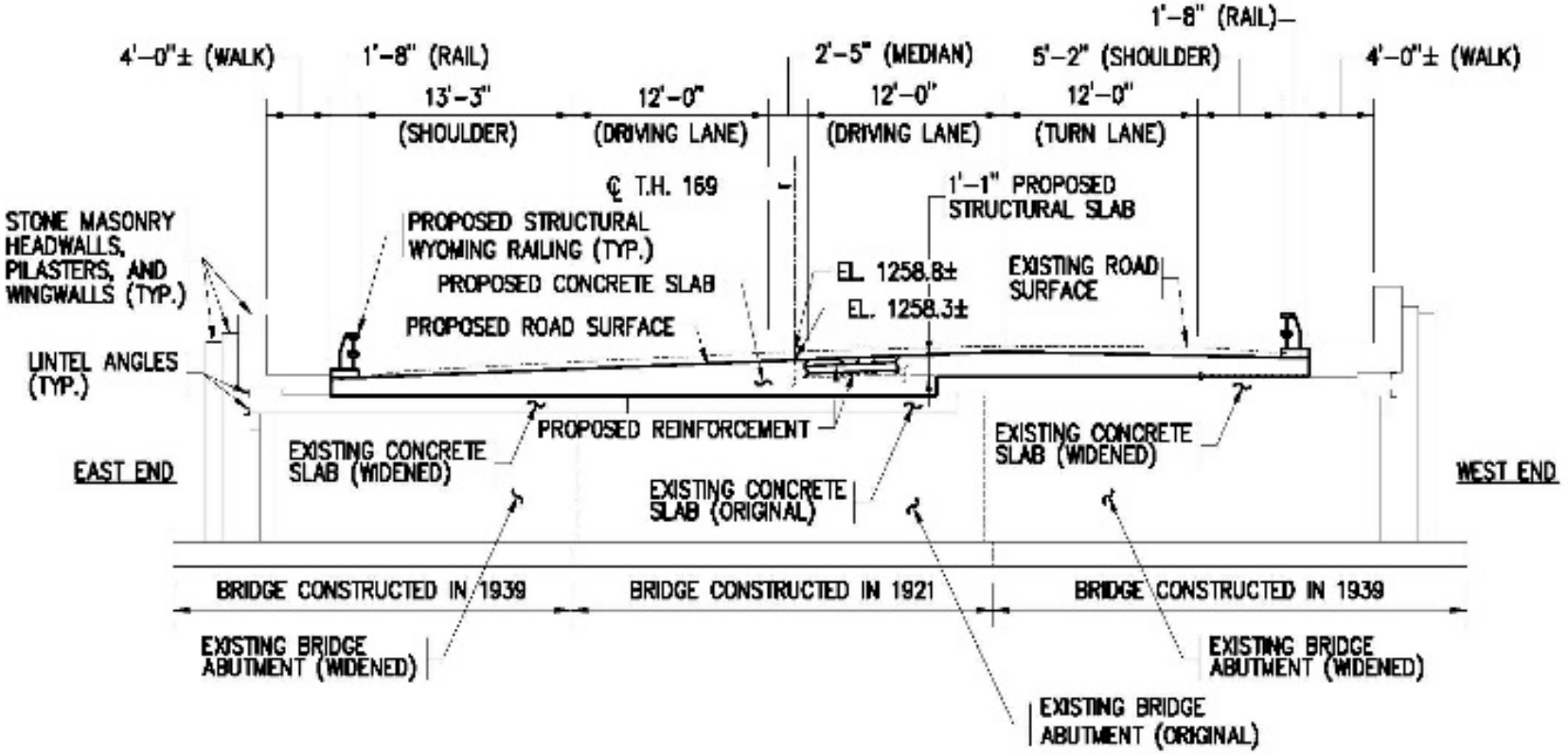


PROPOSED SECTION THROUGH ARCH – COMPOSITE SLAB OPTION

SCALE: 0 2'-8"

(LOOKING SOUTH)

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

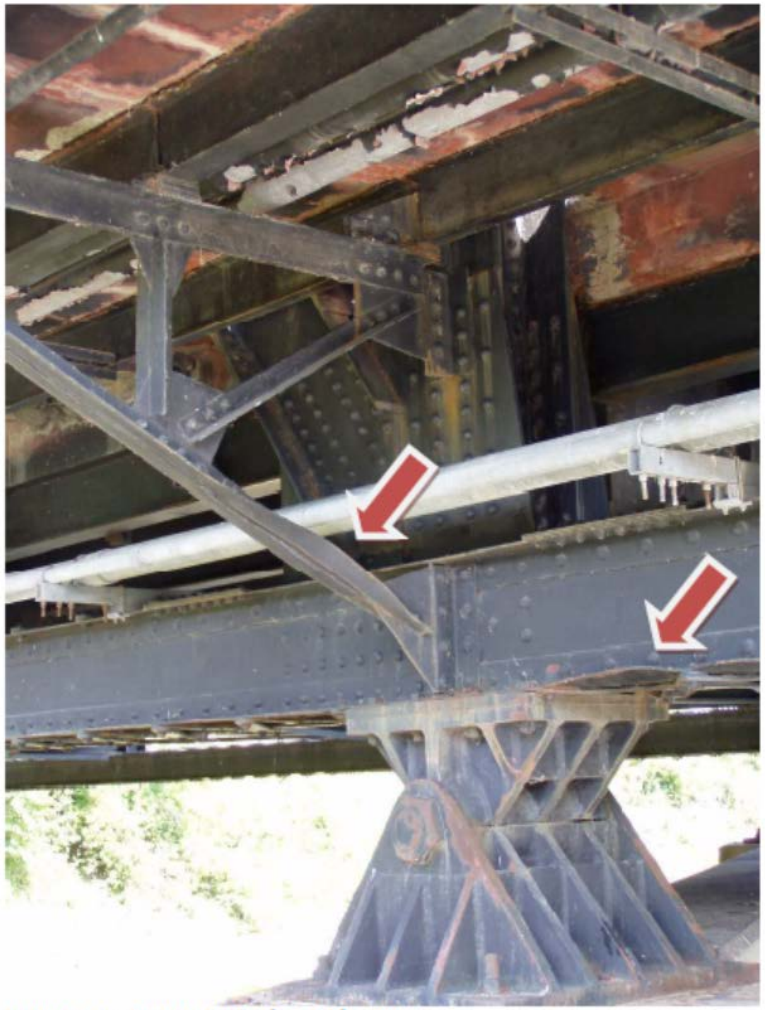
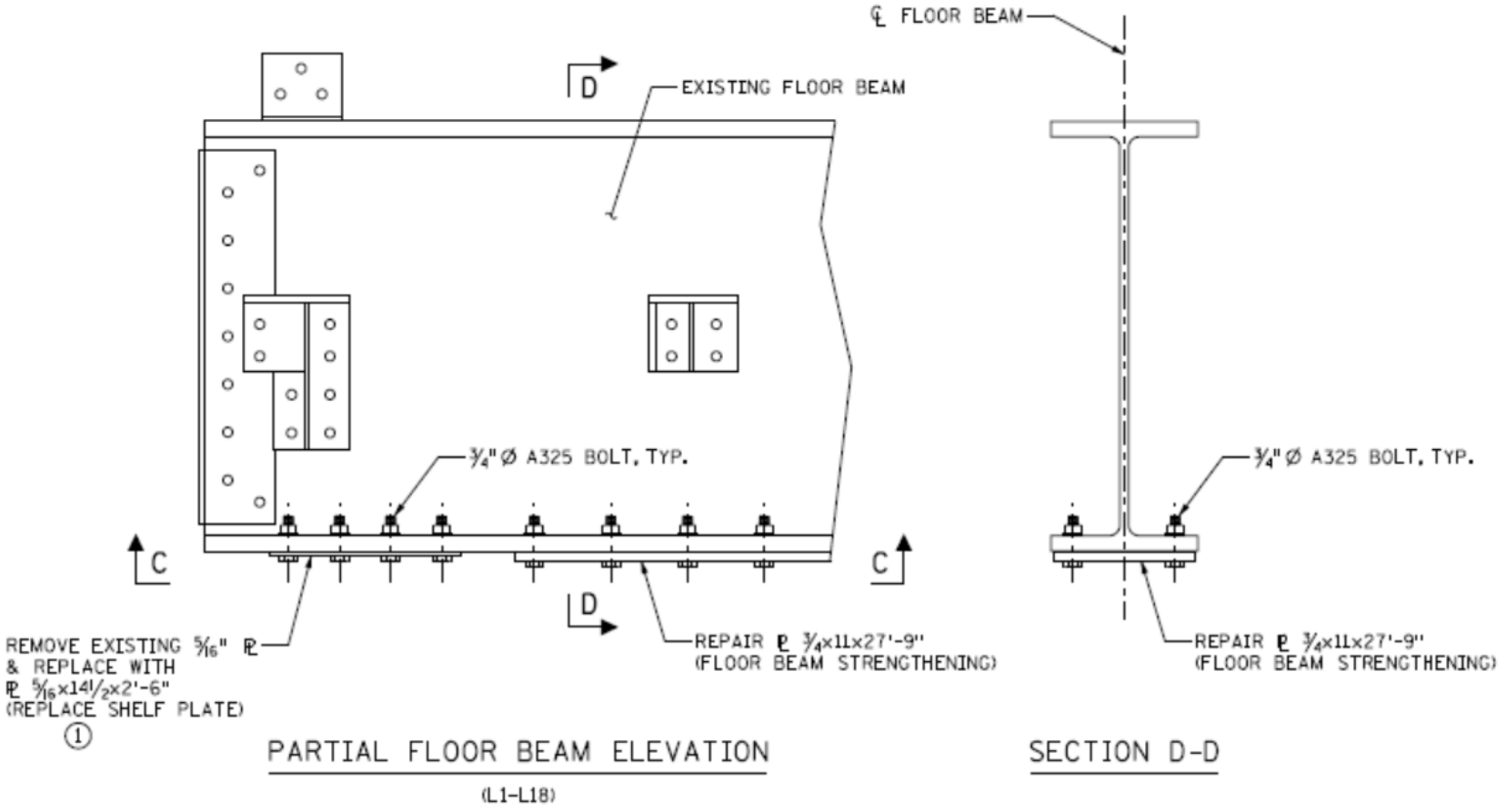


Figure 6 - Truss Details at the Pier

Load Capacity – Broadway Bridge, St. Peter MN



Load Capacity – Broadway Bridge, St. Peter MN

2009 Inventory Form

+ CAPACITY RATINGS +	
Design Load	H 15
Operating Rating	HS 23.60
Inventory Rating	HS 14.20
Posting	
Rating Date	07-22-2008
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 ksi n = 8
Fy = 60 ksi FOR REINFORCEMENT

STRUCTURAL STEEL:
Fy = 50 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

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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

- **[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

Butler Fairman Seufert
CIVIL ENGINEERS

Width – Carrollton Bridge, Carroll Co. IN

BF&S
Butler Fairman Seufert
CIVIL ENGINEERS

Width – Carrollton Bridge, Carroll Co. IN

Butler Fairman Seufert
CIVIL ENGINEERS

Width – Carrollton Bridge, Carroll Co. IN

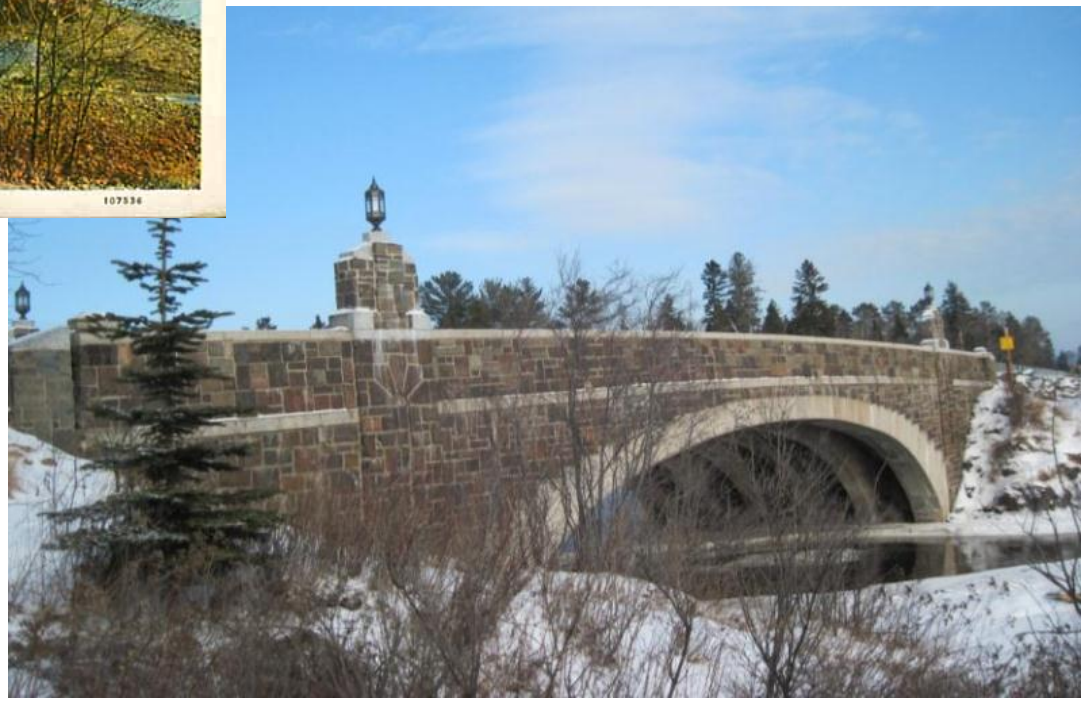
Butler Fairman Seufert
CIVIL ENGINEERS

Width – Carrollton Bridge, Carroll Co. IN

Butler Fairman Seufert
CIVIL ENGINEERS

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

Railings – Bridge 5265, Garrison MN

2”

Railings – Bridge 5265, Garrison MN

3”

Railings – Bridge 5265, Garrison MN

4”

Railings – Bridge 5265, Garrison MN

6”

Railings – Bridge 5265, Garrison MN

4”

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

Oregon Department of Transportation

Railings – Bridge 6679, Houston Co. MN

Railings – Bridge 6679, Houston Co. MN

Railings – Bridge 6679, Houston Co. MN

Original Railing

TL-4

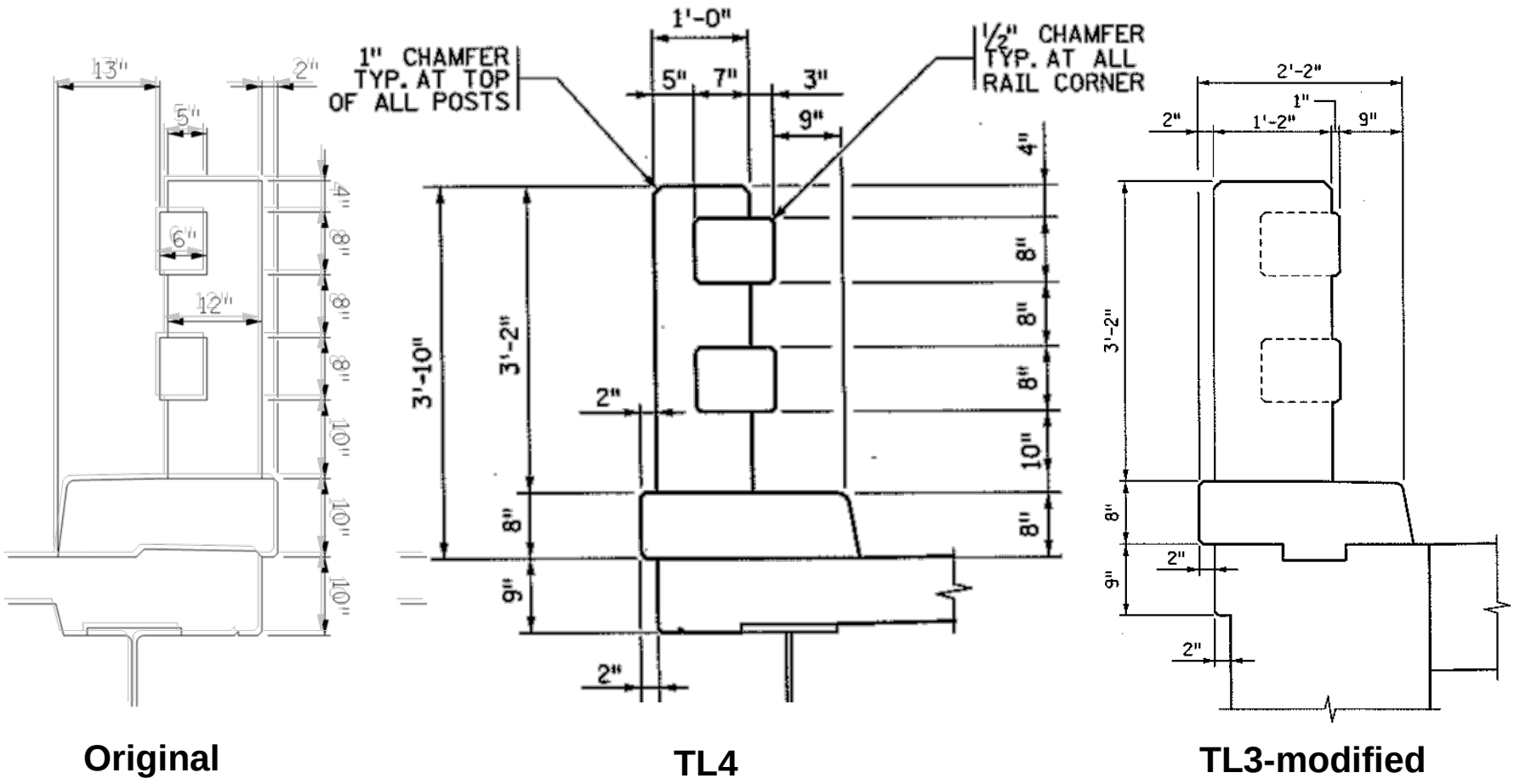
Railings – Bridge 6679, Houston Co. MN

Original Railing

TL-3

Railings – Bridge 6679, Houston Co. MN

- **Solution: Design exception to use TL-3 standard**



Original **TL4** **TL3-modified**

Railings – Bridge 6679, Houston Co. MN

Before

After

Railings – Bridge 6679, Houston Co. MN

Railing mock up

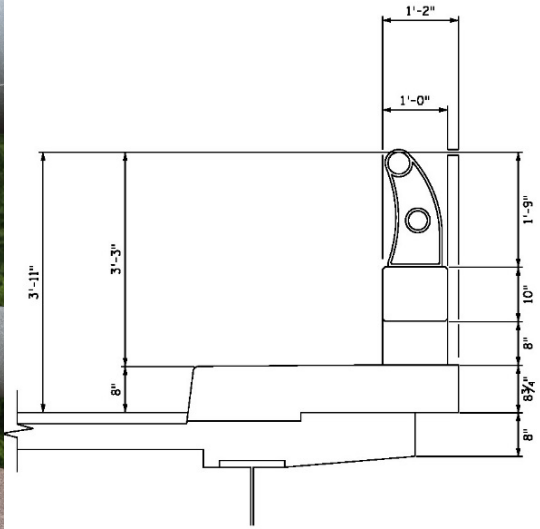
Stain testing

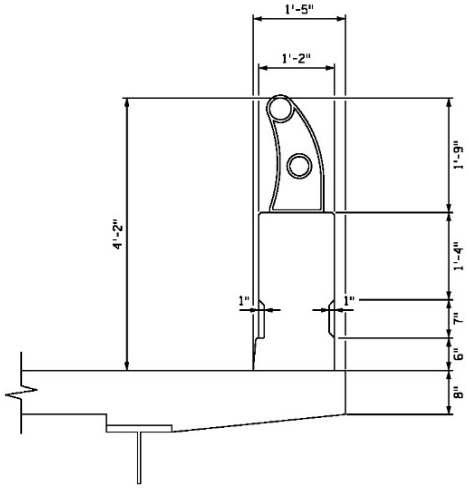
Railings – Bridge 6679, Houston Co. MN

After

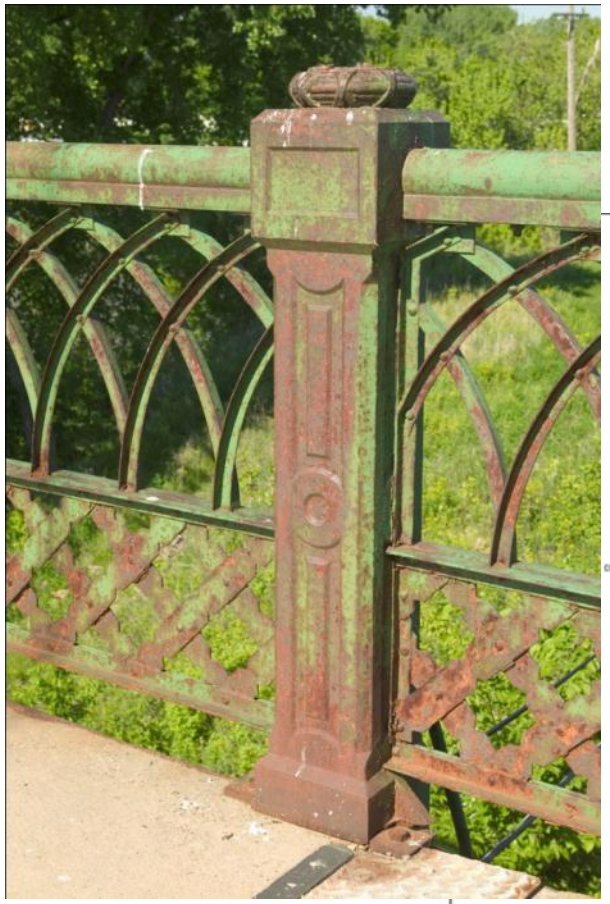
Railings – Bridge 9395, Beaver Bay MN

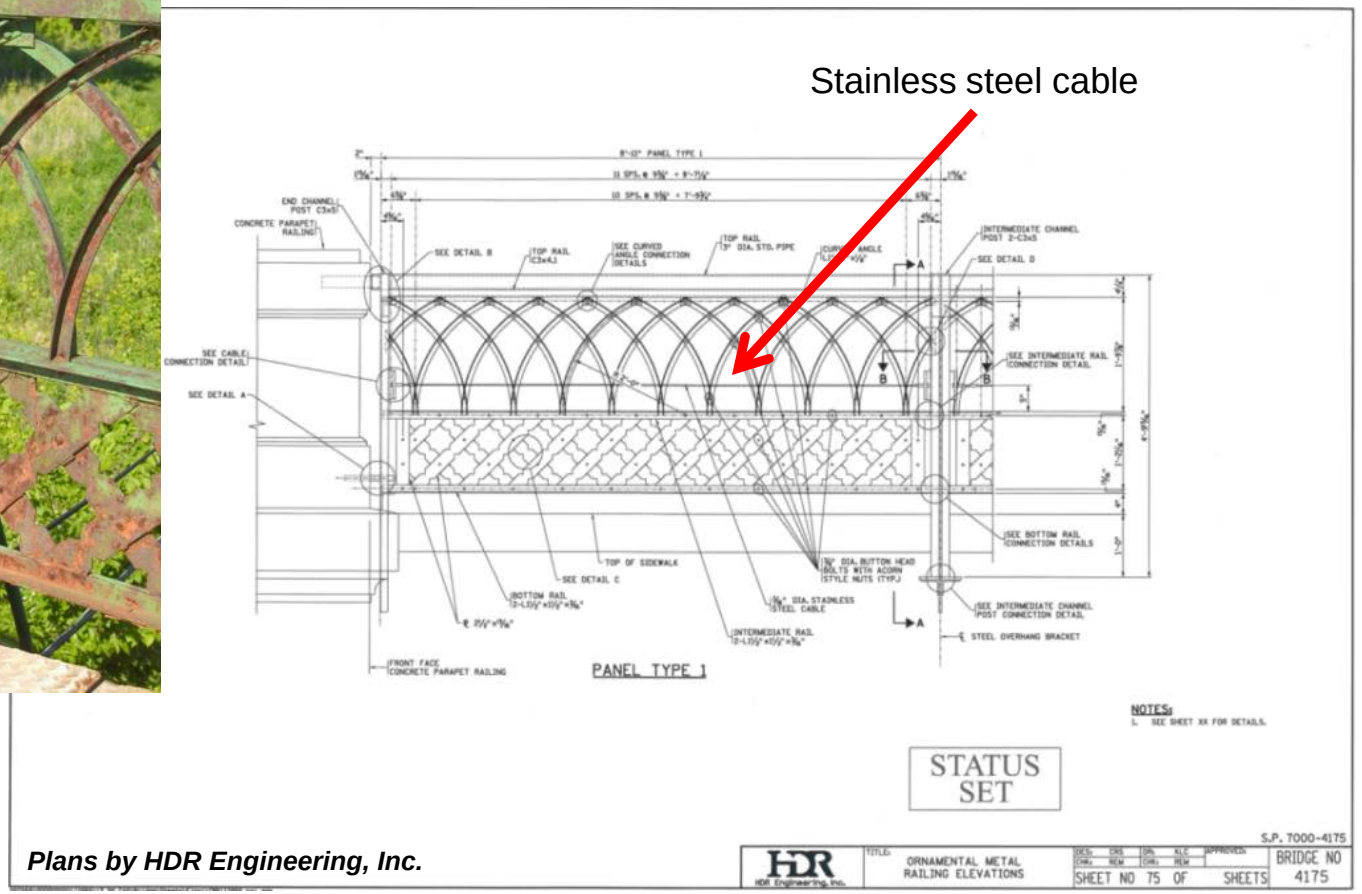
Railings – Bridge 9395, Beaver Bay MN





Railings – Holmes Street Bridge, Shakopee MN





Plans by HDR Engineering, Inc.

Railings – Holmes Street Bridge, Shakopee MN

Railings – Bridge 9053, Bloomington MN

Railings – Bridge 5388, MN

Before

After

Railings – Phelps Mill Bridge, Otter Tail Co. MN

Before

After

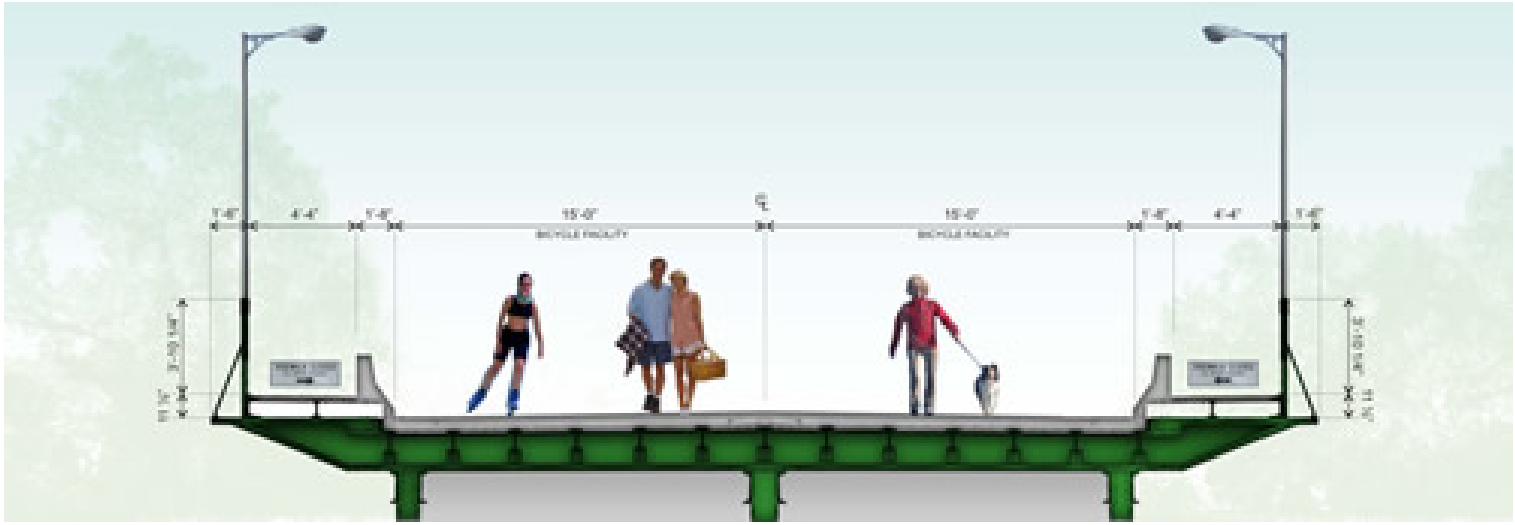
Railings – Stillwater Lift Bridge, Stillwater MN

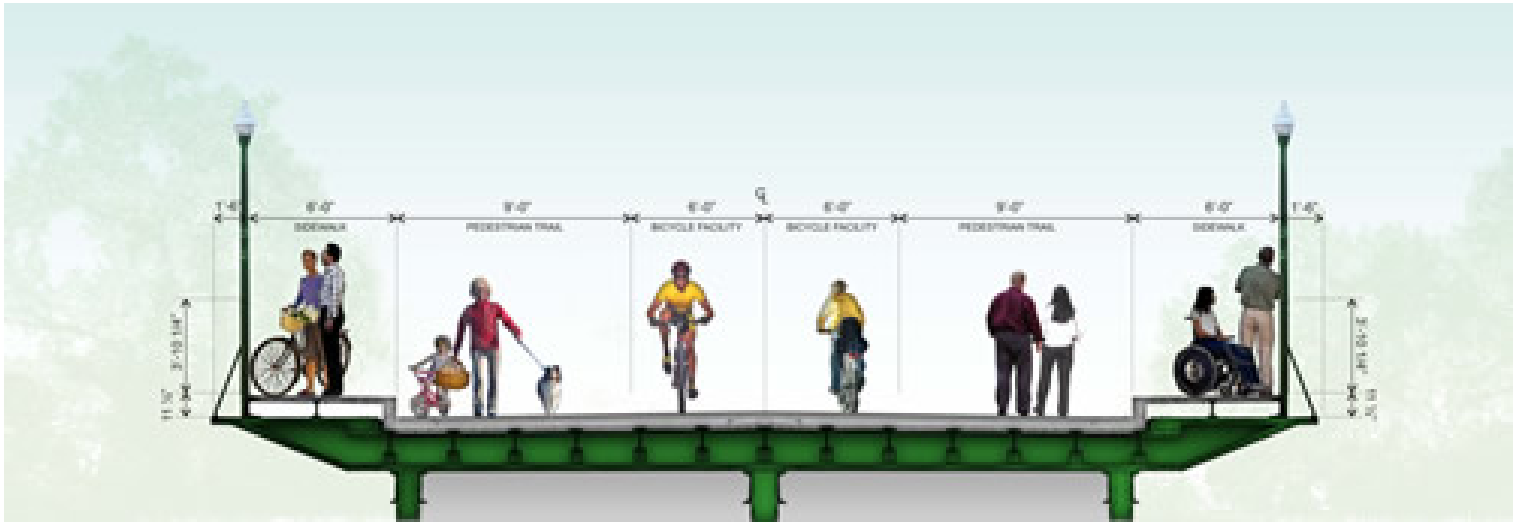
Railings – Swayback Bridge, Redwood Falls MN

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

Construction – Phalen Park Arch Bridge, St. Paul MN

- **[insert video clip]**

Questions and Panel Discussion