GRAY
PLANT
MOOTY

INVESTIGATIVE REPORT TO JOINT COMMITTEE TO INVESTIGATE THE I-35W BRIDGE COLLAPSE

APPENDIX: Volume V

MAY 2008

APPENDIX Volume V

Additional Documents Cited

Tab Number	Description of Document
186	4/17/2008 D. Dorgan memorandum re: Recent Mn/DOT Actions Affecting Bridge Design, Maintenance and Inspection
187	List of 2006 Department of Transportation Awards, provided by Governor Pawlenty's office
188	2/26/08 R. Arnebeck memorandum re "Critical Deficiencies" found during bridge inspections
189	2/7/77 Mn/DOT Project Development Report and Location/Design Study Report
190	11/26/96 MnDOT, Office of Bridges and Structures Preliminary Recommendations for Bridge Improvement, with attached 2/12/97 Minutes on meeting regarding scope of remedial repair to Bridge 9340
191	9/16/98 D. Flemming memorandum re: BR 9340 – Cracks in Approach Span Girders with attached drawing
192	3/2001 University of Minnesota Report: Fatigue Evaluation of the Deck Truss of Bridge 9340
193	3/7/03 R. Miller memorandum re: Mn/DOT Request for Interest ("RFI")
194	3/28/03 HNTB Response to RFI
195	3/28/03 URS Response to RFI
196	5/29/03 Mn/DOT Contract with URS
197	6/2003 URS Initial Inspection Report For: Fatigue Evaluation, Bridge 9340 35W Over Mississippi River
198	12/23/03 MnDOT/URS Contract
199	7/12/04 amendment to MnDOT/URS Contract; 11/4/05 amendment to MnDOT/URS Contract; 4/13/06 amendment to MnDOT/URS Contract; 10/9/06 amendment to MnDOT/URS Contract and 4/5/07 amendment to MnDOT/URS Contract
200	7/2006 URS Draft Report: Fatigue Evaluation and Redundancy Analysis Bridge No. 9340 I – 35W Over Mississippi River
201	8/1/07 B. McElwain email to E. Zhou re: Section 4.3.1
202	5/5/08 D. Dorgan letter to R. Stein
203	1/7/08 M. Pribula OLA Interview Transcript
204	1/12/04 G. Peterson email to B. Iwen, P. Kivisto and P. Rowekamp re: Paint sort final
205	12/1997 contract between MnDOT and Maxim Technologies, Inc.
206	10/23/98 D. Flemming memo to G. Workman re: BR 9340 –

	Cracks in Approach Span Girders, North End of Bridge Near Pier 9
207	10/14/98 M. Pribula memo to J. Pirkl re: Cracked Welds in Approach Spans & Diaphragms at Pier #9
208	11/3/00 D. Flemming memo to G. Workman re: Inspection Frequency on Br. #9330 and Br. #9340
209	5/12/99 University of Minnesota / Mn/DOT Contract
210	10/1/06 MnDOT Bridge Preservation Recommendation
211	2/24/06 R. Schultz email re: Br. #9340 meeting with attached Preliminary Bridge Preservation Recommendations document
212	9/2006 URS Br. 9340 Draft Report Comments and Responses
213	4/5/04 Report for Commissioner's Staff Meeting
214	2/8/05 Report for Commissioner's Staff Meeting
215	3/31/08 Wiss, Janey, Elstner Associates, Inc. DeSoto Bridge Gusset Plate Evaluation
216	10/21/96 Richland Engineering Limited report re: LAK-902342 R over Grand River, Gusset Plate Failure ("REL Report")
217	10/2001 HNTB Proposal for Structural Evaluation of Bridge No. 9340
218	5/9/08 HNTB email
219	Metro Division Bridge Improvement Program FY 2007 – 2013
220	4/14/06 G. Peterson email re: Bridge 9030 Final Report
221	6/19/06 E. Zhou email re: Br. 9340 TH 35W over the Mississippi River investment strategy
222	7/12/06 Mn/DOT Meeting Minutes re: Br. 9340 TH 35W over the Mississippi River investment strategy
223	12/21/98 University of Minnesota letter to D. Flemming re: Bridge No. 9340 – Load Test Results
224	1/2007 URS Bridge 9340 Study – Recommendations on Truss Members Retrofit
225	2/9/07 G. Peterson email re: URS proposal to assist on 9340
226	2783-107 Precon Invite List with attached 6/6/07Attendance Record
227	2/27/06 D. Flemming email re Bridge 9340 Preliminary Recommendations
228	11/7/06 G. Peterson email re: RFP for a monitoring system
229	3/24/06 D. Flemming letter attaching Preliminary Recommendations for Bridge 9340 with attached
230	5/2008 letters from K. Janisch and R. Winter
231	Mn/DOT's Standard Specifications, Section 1513
232	4/14/06 G. Peterson email re: Bridge 9030 Final Report

Minnesota Department of Transportation

Memo
Bridge Office
Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Office Tel: 651/366-4501
Fax: 651/366-4497

April 17, 2008

TO: Robert McFarlin, Acting Commissioner
Lisa Freese, Deputy Commissioner

FROM: Dan Dorgan
State Bridge Engineer

SUBJECT: Recent Mn/DOT Actions Affecting Bridge Design, Maintenance and Inspection

The purpose of this memorandum is to provide an update on actions that have or are being taken in regards to bridge design, maintenance or inspection. These actions are in response to various Federal Highway Administration (FHWA) Technical Advisories, National Transportation Safety Board (NTSB) Safety Recommendations, Office of Legislative Auditor (OLA) Recommendations, learning's from the Wakota Bridge design issues, and Mn/DOT evaluation of desired improvements to processes/policies.

As additional information or recommendations are released by the FHWA or NTSB, we shall implement any necessary changes.

<u>Peer Review of Consultant Designs for Major Bridges</u>

Additional language has been recently added to our Mn/DOT LRFD Bridge Design Manual in Section 1.3.2 regarding consultant design reviews. For major bridges designed by consultants, Mn/DOT will require an independent peer review of the design by a second design firm. This process was described in legislative hearings last fall. The purpose of these requirements is specifically to reduce the potential for a design error in the contract plans. Routine bridge designs will continue to be reviewed by our in-house staff according to the existing language in our Bridge Design Manual.

Review of Gusset Plate Adequacy of Existing Truss Bridges

On January 15, 2008, the NTSB released information citing an error in the original design of the gusset plates at joints U10 and L11 of the I35W Bridge. Mn/DOT developed a procedure for performing engineering review of gusset plates in the Fall of 2007 and had begun reviews of several trusses at the time of the NTSB announcement. In January we set of goal of completing all of those reviews in June for the twenty-five truss bridges on the state system. We currently have seven consultants and five Mn/DOT bridge design engineers conducting those reviews concurrently. That involves a complete load rating of the truss, utilizing the loads from the rating and inspection information to perform a design check of the gussets, and for some bridges an additional field review to supplement inspection report information.

Consultants are also being retained for local bridges in the county and township systems. The advertisement for that work is currently published. The State Aid Office is funding those contracts with federal fund sources.

Statewide Bridge Inspections

The accelerated inspection of all Mn/DOT bridges was completed in December 2007, as directed by Governor Pawlenty following the collapse of the I35W Bridge. Information from those inspections is being utilized by Mn/DOT Districts in planning their maintenance work for 2008. There were only two findings from Mn/DOT bridges that required immediate action. The TH 11 bridge over the Red River was closed for several days in August for steel repairs and a TH 10 bridge near Little Falls was closed briefly to repair damage attributed to a truck hit.

PB Americas will be completing shortly their report assessing Mn/DOTs compliance with National Bridge Inspection Standards.

Documentation of Post Inspection Bridge Maintenance Decisions

The OLA recommended Mn/DOT evaluate District procedures for documenting post inspection bridge maintenance decisions and implement standard practices. While our Districts already had informal processes in place to follow-up inspection results with maintenance actions, we are developing a standard practice for adoption. PB Americas, Inc. is assisting Mn/DOT in a quality improvement review involving District and Bridge Office personnel. We anticipate a policy for implementation will be ready in June of 2008.

Bridge Maintenance Staffing

The OLA recommended Mn/DOT assess the sufficiency of District bridge maintenance staffing. Mn/DOT is committed to meeting bridge preventive maintenance needs and our bridge workers are key in accomplishing that work. Information has been provided to the Operations Division regarding past levels of bridge maintenance workers and studies of this issue. That information is currently being considered by a working group developing FY 2009 maintenance budget recommendations. Revisions to current staffing levels will be recommended by that effort.

Fracture Critical Bridge Inspections

The OLA recommend operating funds be provided to meet inspection frequencies for Fracture Critical Bridges that were revised by the FHWA and implemented in 2006. Mn/DOT performs fracture critical inspections for both State and local bridges. We have estimated eight inspection FTEs plus three FTEs for traffic control are needed along with an additional snooper inspection vehicle. That information has been provided to the Division Directors for Operations and Engineering Services for inclusion in FY 2009 budgeting. Several of those positions have been posted for applicants, thus beginning the process to increase Fracture Critical inspection staffing.

Construction Loads

Mn/DOT Standard Specifications for Construction 1513 restricts the movement of heavy loads and equipment on a highway project for many years. We have added language to construction specifications to limit the contractor's storage of materials on a bridge. The weights allowed basically limit loading from construction materials to levels similar to typical traffic live loads expected on a bridge.

We believe the above bridge initiatives are responsive to the information and investigative results to date. Although we do not know what the Gray Plant Mooty study will yield, we believe these steps should largely address those outcomes.

Should you desire anymore detail on the above items please let me know.

Cc:
Richard Arnebeck
Robert Winter

Department of Transportation

Agency: Department of Transportation
Date: 2006

Recipient: Highway 61
Award: 2006 Perpetual Pavement Award
Award Sponsor: Asphalt Pavement Alliance
Description: An eight-mile section of Hwy 61 between Wabasha and Kellogg in District 6 received the award for overall pavement structure stability, which is given for highways with pavement at least 35 years old that demonstrate the qualities of excellence in design, quality in construction, and value to the traveling public. Construction on this segment of Hwy 61 began in 1969.

Agency: Department of Transportation
Date: 2006
Recipient: Michael Ritchie, hazardous materials specialist, Office of Freight and Commercial Vehicle Operations
Award: National Recognition Award
Award Sponsor: Institute of Electrical and Electronics Engineers
Description: Awarded for efforts to improve electronic communications during hazardous materials incidents.

Agency: Department of Transportation
Date: 2006
Recipient: Mn/DOT
Award: Environmental Awards
Award Sponsor: Federal Highway Administration
Description: Three Mn/DOT initiatives received the awards.

Agency: Department of Transportation
Date: 2006
Recipient: Mn/DOT
Award: Honors
Award Sponsor: Preservation Alliance of Minnesota
Description: Honored for the restoration of the historic Hwy 61 bridge over the Lester River in Duluth and for plan to preserve other historic bridges in the state.

Agency: Department of Transportation
Date: 2006
Recipient: Highway "ROC" 52 reconstruction project
Award: Merit Award
Award Sponsor: Design Build Institute of America

Description: Received for "breaking new ground" in the area of project delivery.

Agency: Department of Transportation
Date: 2006
Recipient: Hwy 38 reconstruction project in District 1; Metro District Interstate 394 MnPASS high occupancy toll lane project.
Award: Excellent Awards
Award Sponsor: Federal Highway Administration
Description: The awards were for projects, facilities and processes that were the best in highway design.

Agency: Department of Transportation
Date: 2006
Recipient: Hwy 23 reconstruction project in District 8; Hwy 371 Brainerd Lakes Area Welcome Center and Rest Area in District 3; Visual Quality Management project development process
Award: Merit Award
Award Sponsor: Federal Highway Administration
Description: The awards were for projects, facilities and processes that were the best in highway design.

Agency: Department of Transportation
Date: 2006
Recipient: Hwy 100 reconstruction in the Metro District; Hwy 53 Piedmont Avenue reconstruction project in District 1/Duluth; I-35W/66th St. interchange/gateway construction project in the Metro District; Hwy 61 Lester River bridge reconstruction in District 1/Duluth; Loring bikeway and bridge construction
Award: Honorable Mention
Award Sponsor: Federal Highway Administration
Description: The awards were for projects, facilities and processes that were the best in highway design.

Agency: Department of Transportation
Date: March 16, 2006
Recipient: Six Mn/DOT concrete paving project
Award: Awards for Excellence
Award Sponsor: Minnesota Concrete Pavers Association

Description: The awards were judged on criteria that included pavement smoothness, appearance, level of project difficulty and whether they met designed strength and density levels.

Agency: Department of Transportation
Date: April 13, 2006
Recipient: Lisa Freese
Award: 2006 Woman of the Year
Award Sponsor: Women in Transportation Studies
Description: Freese received the award for her leadership, hard work, and extensive knowledge.

Agency: Department of Transportation
Date: April 18, 2006
Recipient: Mn/DOT
Award: Research Partnership Award
Award Sponsor: Center for Transportation Studies
Description: Award received for their Metro Evacuation Traffic Management Plan.

Agency: Department of Transportation
Date: May 1, 2006
Recipient: Mn/DOT
Award: Excellence in Utility Relocation and Accommodation Award
Award Sponsor: FHWA
Description: The award recognized a joint effort to develop a new utility coordination process that will minimize project delays, construction costs and contractor claims while increasing the number of utility relocations that can be done before construction work begins.

Agency: Department of Transportation
Date: May 1, 2006
Recipient: Mn/DOT
Award: Excellence in Right-of-Way Stewardship Award
Award Sponsor: FHWA
Description: Received for the 2005 Right-of-Way Professionals Workshop.

Agency: Department of Transportation
Date: July 2006
Recipient: Mn/DOT

Award:

Award Sponsor:

Description: The award recognizes the department's statewide and district long-range transportation plans.

Agency: Department of Transportation

Date: July 2006

Recipient: Mn/DOT

Award:

Award Sponsor: Federal Highway Administration; Federal Transit Administration

Description: Received for the Statewide Freight Plan, cited for its comprehensive scope to identify issues and trends and its development of policies needed to address them.

Agency: Department of Transportation

Date: September 18, 2006

Recipient: Aeronautics' Aviation Education Section

Award: Honors

Award Sponsor: National Association of State Aviation Officials

Description: Received for its Aviation Career Curriculum and Education Program.

Agency: Department of Transportation

Date: October 5, 2006

Recipient: Joella Givens, Metro District GIS manager

Award: Polaris Leadership Award

Award Sponsor: Minnesota GIS/LIS Consortium

Description: The award is presented to mid-career professionals who have shown leadership and provided inspiration to others in the geographic and land information systems field.

MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 08-02-B-02
February 26, 2008

To: Distribution 57, 612, 618, and 650

From: Rick Arnebeck
Director, Engineering Services Division

Subject: "Critical Deficiencies" found during bridge inspections

Expiration

This new Technical Memorandum supersedes TM-05-02-B-02 and it will expire February 26, 2013 unless superseded prior to this date.

Implementation

This policy and its instructions are effective immediately for state and local bridges.

Introduction

This Technical Memorandum establishes a formal procedure for responding, reporting, and documenting "Critical Deficiencies" found during scheduled bridge inspections.

Purpose

The Federal Highway Administration requires that all states develop a process to monitor critical deficiencies found during bridge inspections. This Technical Memorandum is intended to provide the necessary guidelines to fulfill the FHWA requirements. The guidelines described in this document are based on the **"Critical Deficiency Procedures"** as outlined in Section 3.8.1.4 of the AASHTO Manual for Condition Evaluation of Bridges which states:

> Critical structural and safety related deficiencies found during the field inspection and/or evaluation of a bridge should be brought to the attention of the Bridge Owner immediately if a safety hazard is present. Bridge Owners should implement standard procedures for addressing such deficiencies, including:
>
> - Immediate critical deficiency reporting steps
> - Emergency notification to police and public
> - Rapid evaluation of the deficiencies found
> - Rapid implementation of corrective or protective actions
> - A tracking system to ensure adequate follow-up actions
> - Provisions for identifying other bridges with similar structural details with follow-up inspections

It is recognized nationally that some past bridge failures may have been prevented if prompt attention had been given to concerns noted on bridge inspection reports. To ensure public safety, it is essential that "Critical Deficiencies" not only be brought to the attention of those responsible but that these findings are reviewed to confirm that all necessary corrective actions have been completed.

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Guidelines

For the purpose of this Technical Memorandum, the following definitions shall apply.

Critical Deficiency: A "Critical Deficiency" is defined as any condition discovered during a scheduled bridge inspection that threatens public safety and, if not promptly corrected, could result in collapse or partial collapse of a bridge. Critical findings include structural conditions and scour or hydraulic conditions that are found to be critical during the inspection or that are likely to become critical to the stability of the bridge before the next regularly scheduled inspection.

Hazardous Deficiency: A Hazardous Deficiency is defined as an element level condition found during a regularly scheduled bridge inspection that may be hazardous to public safety, but IS NOT expected to lead to collapse or partial collapse of the bridge. While any "Hazardous Deficiency" found during a bridge inspection should immediately reported to the bridge owner (or appropriate authority), the Mn/DOT Bridge Office requires no subsequent documentation.

Bridge: A "bridge" is defined as any bridge, culvert, tunnel, or other structure listed on the Mn/DOT Bridge Inventory.

Bridge Inspection: A "bridge inspection" includes any routine inspection, special inspection, hands-on Fracture Critical inspection, or underwater inspection performed on a bridge.

Bridge Inspector: A "Bridge Inspector" is defined as the inspection team leader which is a certified Level 2, Level N or Level E inspector - this includes inspectors employed by Mn/DOT, Counties, Cities, or by private consultants.

Engineer: The "Engineer" is defined as the supervising registered Professional Engineer of the entity listed on the Mn/DOT Bridge Inventory as having "report jurisdiction" for the bridge. In most cases, this will be the Mn/DOT District Bridge Engineer, the County Engineer, or the City Engineer.

Bridge Owner: The "Bridge Owner" is defined as the entity listed on the Mn/DOT Bridge Inventory as the Owner of the bridge.

Mn/DOT Bridge Inspections Engineer: The "Mn/DOT Bridge Inspection Engineer" refers to the State Bridge Inspection Engineer who is the primary statewide contact for reporting Critical Bridge Deficiencies.

Mn/DOT Bridge Inspection Engineer
3485 Hadley Ave. North
Oakdale, MN 55128
(651) 366-4567

Critical Deficiency Process: The following guidelines outline and describe the procedures to be followed if a Critical Deficiency is observed during a bridge inspection. These guidelines are divided into three parts, Responsibilities of the Bridge Inspector, Responsibilities of the Engineer with Reporting Jurisdiction, and Responsibilities of the Mn/DOT Bridge Inspection Engineer.

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Part 1 - Responsibilities of the Bridge Inspector: Upon discovery of a "Critical Deficiency"; the Bridge Inspector is responsible for the following:

1) **Emergency Bridge Closure:** If the observed condition is severe enough to warrant immediate closure of the bridge (or immediate restriction of traffic above or below the bridge), the Bridge Inspector shall immediately take any actions necessary to ensure public safety.

2) **Prompt Notification of the Engineer:** Upon discovery of a Critical Deficiency, the Bridge Inspector shall promptly notify the Engineer. The inspector should identify the bridge number, bridge location, and clearly and accurately describe the critical condition.

3) **Inspection Report:** In addition to the prompt verbal notification, the following written documentation must be completed:

    a) If the Critical Deficiency is observed during a routine (NBI/PONTIS) inspection, the inspector should rate the "Critical Finding Smart Flag" (PONTIS element #964) as "Condition State 2", and briefly describe the critical finding (if necessary, supplemental notes, sketches, photos, and measurements should be included to fully describe the situation) and submit the inspection to the Engineer.

    b) If the Critical Deficiency is observed during a hands-on Fracture Critical inspection, underwater inspection, or other special inspection, the inspector must submit a brief written statement or report describing the condition (as described in step 2 above) to the Engineer within 48 hours after finding the Critical Deficiency.

Part 2 - Responsibilities of the Engineer: Upon being notified of a Critical Deficiency, the Engineer is responsible for the following...

1) **Rapid Evaluation:** The Engineer is required to quickly assess the situation to confirm or refute the finding, and to initiate necessary traffic restrictions to safeguard the public. If in doubt, the Engineer should temporarily close or restrict traffic on the bridge, then contact a consulting bridge engineer, the Mn/DOT Bridge Inspection Engineer, or the Mn/DOT Bridge Office (651) 366-4500 for assistance. If the Engineer determines that the condition reported is not a Critical Deficiency, the "Critical Finding Smart Flag" (PONTIS element #964) can be changed back to "Condition State 1" after discussing with the inspector (the Mn/DOT Bridge Office requires no subsequent documentation).

2) **Traffic Control & Public Notification:** The Engineer shall be responsible for coordinating all necessary traffic control (such as load restrictions, lane or bridge closures, or detours). The Engineer shall also be responsible for the public notification of any traffic restrictions.

3) **Immediate Notification of the Bridge Owner:** If the bridge owner (as listed on the Mn/DOT Inventory) is different than the entity with "report jurisdiction", the Engineer shall be responsible for informing the Bridge Owner that a Critical Deficiency has been found.

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4) **Submittal of Inspection Report to the Mn/DOT Bridge Inspection Engineer:** Within 7 days after a Critical Deficiency has been reported, the Engineer must notify Mn/DOT's Bridge Inspections Engineer of the finding and must submit a copy of the inspection report.

5) **Rapid Implementation of Corrective Action:** The Engineer is responsible for promptly scheduling repairs to the bridge. If the bridge remains open to traffic, the Engineer is responsible for determining the proper load rating for the bridge, and ensuring that the rating is adequately posted.

6) **Resolution of Deficient Status:** After repairs have been completed, the Engineer should change the "Critical Finding Smart Flag" (PONTIS element #964) rating to "Condition State 1", and add a brief description of the corrective actions taken in the inspection notes for that smart flag. A copy of the revised inspection report must then be submitted to the Mn/DOT Bridge Inspection Engineer.

7) **Updating of the Bridge Inventory:** If the bridge load rating is permanently reduced, the Engineer must submit a new load rating to the Mn/DOT Bridge Inspection Engineer. If the bridge is closed to traffic, the Engineer must notify the Mn/DOT Bridge Inspection Engineer.

Part 3 - Responsibilities of the Mn/DOT Bridge Office:

1) **Provide Immediate Assistance:** Requests for assistance in evaluating a Critical Deficiency should be directed to the Mn/DOT Bridge Inspection Engineer (or, if not available, to other available resources within the Mn/DOT Bridge Office) - such requests will be given priority over other work. If a Critical Deficiency is confirmed, a brief written report should be filed with the Mn/DOT Bridge Inspections Engineer. Requests for assistance with follow-up inspections should be directed to the Mn/DOT Bridge Office Bridge Inspection Unit. Requests for repair recommendations should be directed to the Mn/DOT Regional Bridge Construction Engineer (651) 366-4500.

2) **Recording the Critical Finding:** Upon receipt of a written or oral report or the Bridge Inspection Report describing the Critical Deficiency from the Engineer, the Mn/DOT Bridge Inspection Engineer will enter the bridge number and date of the inspection in a Critical Deficiency Log, will create a separate file for the bridge to track resolution of the problem, and will require the critical finding to be entered promptly into the PONTIS Bridge Management System. The Critical Deficiency Log will be available upon request.

3) **Follow-up:** The Mn/DOT Bridge Inspection Engineer shall monitor the situation as necessary until the situation has been resolved and written notification of corrective action has been received. If notification is not received within 30 days, the Bridge Inspections Engineer shall contact the Engineer (or Bridge Owner) for further information.

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4) **Documenting the Resolution of the Deficiency:** After the notification of corrective action has been received from the Engineer, the Mn/DOT Bridge Inspection Engineer shall enter the date of resolution in the Critical Finding Log and shall file all related documents.

5) **Updating of the Bridge Inventory:** Upon notification that a bridge has been closed, or that a bridge load rating has been permanently reduced, or that repairs have been completed, the Mn/DOT Bridge Inspection Engineer will forward the information to the Bridge Management Unit so the bridge inventory can be properly updated.

6) **Annual Reporting of Critical Bridge Deficiency Status:** Prior to May 1st of each year (which coincides with the annual submittal of the bridge inspection data to the FWHA), the Mn/DOT Bridge Inspections Engineer will report the status of Critical Bridge Deficiencies to the State Bridge Engineer. The status of Critical Deficiencies that have been logged during the past year, and any additional bridges in the PONTIS database with Element #964 in Condition State 2 will be included in the report.

Questions
Any questions regarding this Technical Memorandum should be directed to **Todd Niemann, Mn/DOT Bridge Inspection Engineer, 3485 Hadley Ave. North, Oakdale, MN 55128, (651) 366-4567**.

Any questions regarding the publication of this Technical Memorandum should be directed to designstandards@dot.state.mn.us. A link to all active Memoranda and a list of historical Technical Memoranda can be found at: http://www.dot.state.mn.us/atoz.html.

-END-

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

PROJECT DEVELOPMENT REPORT
and
LOCATION/DESIGN STUDY REPORT
for

SP 2783-85 - 2783-9340 - 2783-9340A

Minnesota Project No. I IG-IR 35W-3 (182)106

Bridge Deck Restoration and

Entrance Median Construction

Bridge 9340 and 9340A on I35W

over Mississippi River Minneapolis

Hennepin County

APPROVED:

2/7/77

District Engineer

APPROVED:

2/10/77

Assistant Commissioner - Highway Division

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PROJECT IDENTIFICATION

The proposed project consists of bridge restoration and minor related construction on Bridges 9340 and 9340A over the Mississippi River and 2nd Street in Minneapolis, Hennepin County.

INTRODUCTORY SUMMARY

Purpose of Report

The purpose of this report is to document the process used to select the project development path. It also contains studies and other considerations used in determination of the preferred location and design, and the consideration of social, economic and environmental effects.

Purpose of Project

The purpose of the proposed project is the restoration of the bridge deck and the standardization of the south bound entrance median (see layout, page 22).

Possible Impact

This project will have no significant impact on the surrounding environment.

PROJECT DEVELOPMENT PATH

Path Selected

The development path for this project will be minimal as defined in the Action Plan for the following reasons:

-- This project will not require additional right of way.

-- This project presents no threat to existing wildlife or vegetation.

-- This project has no significant adverse effect on the human population or abutting real property.

-- This project will not cause a permanent change in the surrounding environment.

Federal Action Determination

The proposed improvement has been evaluated and it has been determined that this project is a non-major action. Therefore, no Environmental Impact Statement will be prepared.

Time Schedule

Design Approval	February 1977
Letting	March 25, 1977
Construction Completion	Fall 1977

Funding

Federal funding is anticipated under the interstate program. Total cost of the project is estimated to be $900,000.

Project Manager

The designated project manager for this project is Mr. Clint Rud, District 5, Minnesota Department of Transportation. He can be contacted at 2055 North Lilac Drive, Golden Valley, Minnesota 55422 or by calling (612)545-3761 extension 115.

PROJECT DISCUSSION

Inplace Facility

Bridges 9340 and 9340A qualify for a deck protective system because of age, current deck condition, traffic volumes and geometrics.

A temporary entrance median (ramp nose) was constructed to provide room for a pedestrian crossing in the original construction. This crossing was needed at that time because Bridge 2796 (10th Avenue Bridge) was under repair. This bridge is now in service so a pedestrian crossing is no longer needed on Bridge 9340.

Objective of Project

It is the objective of this bridge restoration project to extend the service life of the bridges and to obtain the lowest possible cost per year maintenance on the bridges. Bridge deck protective systems reduce salt penetration into the bridge deck. Improved rideability and safe usage of the bridges will also be accomplished by the bridge improvement program.

It is the objective of the entrance median construction to replace the temporary inplace median with the standard entrance median originally designed for this roadway (see standard plate number 7106D on page 21).

Proposed Construction

The proposed construction consists of surface preparation of the bridge deck which includes scarifying 1/4 inch the whole deck, removal to top of rebars, removal to below top of rebars and full depth removal. The deck will be resurfaced with a low slump or latex modified concrete. Also, a misplaced relief cut south of Bridge 9340 must be repaired. Updating of the inplace median guardrail will be included along with other related improvements. (See pages 7 to 20 for details.)

An exit median nose (Standard Plate 7106D) will be constructed at the entrance ramp on the west end of the bridge. This type median nose is being used because of the nearness of the bridge and the bridge approach panel (see page 21 for standard plate and page 22 for layout).

Public Hearing

Public hearings are not required for these projects as:

- All work will be done on existing right of way.
- Adjacent property will not be adversely effected.
- There will be no change in access.

A-95 Clearinghouse and 3-C Planning Requirements

In accordance with the Memorandum of Understanding with the Metropolitan Council, this project is exempt from further A-95 Clearinghouse and 3-C Planning Requirements.

Alternates

Preferred alternate

The preferred alternate will extend the service life of the bridge, obtain the lowest cost-per-year maintenance for the bridge and provide for safe usage of the bridge.

Do nothing alternate

The do nothing alternate does not provide for protection against bridge deck deterioration or standardize the areas of need at the project location.

ENVIRONMENTAL ASSESSMENT

Setting

Bridge 9340 and 9340A are located on I35W over the Mississippi River. Property in the four quadrants consists of commercial, light industrial and residential.

Br. No. 9340

Rehabilitation 1998

Dist. Appv'd, A. Ottman

BS9340.KB

MINNESOTA DEPARTMENT OF TRANSPORTATION
OFFICE OF BRIDGES AND STRUCTURES

PRELIMINARY RECOMMENDATIONS FOR BRIDGE IMPROVEMENT

BRIDGE NO. 9340

RDWY. AREA
(SQ. FT.) 183,930 T.H. 35W OVER Mississippi River, RR, & 2nd St. (Mpls) DIST. NO. Metro
Length 1907' Span Lngths 53'-72'-110'-110'-71'-266'-456'-266'-130'-94'-68'-47'-58'-30' Rdwy. Width 2@52' Type 401
Other Features South 5 spans are welded beams, 3 deck truss spans, 3 welded beams spans, 3 voided slab spans
Tentative Letting Date 01/23/98
Current ADT 120,000 (1992)
Bridge Designer A. Ottman
Year Built 1967
Appr. Pavement
Inventory Ratings: Existing HS 20.0
Appr. Shoulder
After Reconstruction

Scope of Work	Preliminary Recommendations By Bridge Engineer Yes	No	Comment
Type of System Recommended			
a) 2" Low slump concrete		X	
b) 1-1/2" Latex modified concrete		X	
c) Other (See comments)	X		B-1
Slab Preparation			
a) Routine scarification and removal		X	
b) Total deck slab removal		X	
c) Dust control		X	
d) Other (see comments)	X		B-2
Railing Modifications			
a) Replace	X		B-3
b) Repair	X		B-4
c) Protective Screening Requested by district			
d) Other (See comments)		X	
Widening			
a) Widen on existing beams		X	
b) Widen substructures		X	
Joints			
a) Install new waterproof devices	X		B-5
b) Other		X	

BRIDGE NO. 9340

Scope of Work

Recommendations By Bridge Engineer

	Yes	No	Comment
Substructure Repair			
a) Bearings		X	B-6
b) Other	X		B-7
Drainage Modifications			
a) On bridge	X		B-8
b) Off bridge		X	
Approach Modifications			
a) Tapers		X	
b) New panels		X	
c) Treatments		X	
d) Relief Joints		X	
e) Guard Rails		X	
f) Slope Protection		X	
Loop Detection Systems			
a) Are any visible on the bridge?		X	
b) Are any visible on the approach panels?		X	
Traffic Control (District to indicate method with recommendation by Bridge Engineer only if traffic should not be carried during reconstruction)			
a) By pass or detour			

Based on a recent field review of this bridge, the above restoration procedures are recommended. A recent deck condition survey is not available at this time and final detailed recommendations will be made at the time the survey is completed. Copies of final recommendations will be furnished to the FHWA for attachment to the Design Study Report (if appropriate). Bridge Office comments:

Paul A Rowekamp, Metro Region Br. Engr. Date: November 6, 1996

Approved John R. Allen for, State Bridge Engr. Date: 11/6/96

The District concurs in all Bridge Office preliminary recommendations except as noted on this form. District comments:
Metro Division requests that Special Provisions provide a time interval to allow Mn/DOT personnel to sound bridge deck for delamination when roadway is closed to traffic.

Approved C J Hoffstedt for, District Engineer Date: 11/26/96

These repair recommendations are for renovations that are needed to extend the life of this structure until major rehabilitation is initiated. It is anticipated that a major rehabilitation, including deck replacement, will happen in a 10-15 year time frame.

B-1) A 2 inch thick low slump concrete overlay was placed on this bridge in 1977/78. Any cracks in the overlay should be sealed to prevent salt & water from reaching the uncoated steel reinforcing bars in the structural slab.

B-2) The bottom side of the concrete deck overhang along the median and the outside of the bridge has spalled and exposed many reinforcing bars in the bottom mat of reinforcing steel. These areas should be sandblasted clean and covered with shotcrete.

B-3) The existing steel post and guardrail system that runs along the median should be removed and be replaced with back-to-back "J" type barriers or short vertical concrete barrier walls.

B-4) Considerable areas of the existing concrete railing along the sides of the bridge are unsound. A 9" concrete face should be added along each side of the bridge.

B-5) Replace the rubber gland in the joints at the south abutment, pier 11, and the north abutment.

B-6) The hinge joint near pier 2 has closed completely. This condition has existed for at least 10 years, and possibly much longer. To properly correct this problem all the beams in the southern most span would need to be repositioned. Since no major side effects have developed from this condition over the past 10 years, the work to reposition the beams will be postponed until the deck is replaced in 10-15 years.

B-7) Several columns and pier caps on the north end of the bridge were repaired using shotcrete 5-10 years ago by the city of Minneapolis in a demonstration for Mn/DOT. A small area (50SF) of the cap at pier 11 has delaminated. This area should be repaired with shotcrete as part of this repair contract.

B-8) The existing trough drainage system at the ends of the truss spans will be removed. A redesigned system should be installed.

Additional Recommendations/Notes

B-9) The paint condition of the existing steel superstructure framing below the median joint is deteriorating rapidly. A separate recommendation will be issued to cover painting needs. The original design plan indicates that the existing prime coat is lead based (Mn/DOT 3509, Dull Orange), a first field coat of lead based paint(Mn/DOT 3515), a second field coat of lead based paint (Mn/DOT 3517), and a top coat of dark green lead based paint (Mn/DOT 3524). The required painting will be included in this repair contract.

B-10) The truss chords and diagonals are comprised of fabricated box members that have many 6" x 12" and 6" x 24" perforations (holes). To prevent pigeons from nesting inside the chord members, the holes should be covered. The covering system should have small ventilation holes and should be designed such the covers can be removed and reattached during future bridge inspections. Prior to placing the covers the entire length of the inside of the truss chords and diagonals should be power washed clean.

B-11) Inspections over the last several years indicate that the bearings at the north end of the truss spans may be "froze" or have limited movement. The Mn/DOT Design Section will immediately be contacted to devise a system for measuring the actual movement of the bearings. It is intended that the movement monitoring system be installed in the fall/winter of 1996/97. Depending on the amount of movement measured, repairs may be added to remedy the problem.

B-12) Inspection reports from 1995 and 1994 indicate that several of the bolts that connect the stringers to the floor beams in the truss spans have loosened or are broken. The affected bolts should be replaced as part of this contract.

Minutes on meeting regarding scope of remedial repair to Bridge 9340.

Date: 02/12/97, Room 220 Bridge Office, from 9:00 to 11:00

Attendees: Jack Pirkl, Roger Schultz, Paul Rowekamp, Donovan Hoff, Terry Moravec, Arlen Ottman, Erik Wolhowe, Don Peterson, and Bob Fiereck. Minutes by E Wolhowe

1. Drain System
   - A. Concerns were expressed regarding the access. Bob is to arrange a meeting at the site to determine if work can be done from below the deck.
   - B. If access from below is too limited, then removing the finger joints and working from above is an acceptable alternative. This would provide a means for tying the workers to a safety line and for removing the trough with equipment from above and for installing the 'curtain'. or other system drains — storm sewer
   - C. Concern was expressed about not directing the runoff to the ~~sewage~~ system as shown on the original plans. It was noted that because the current trough is plugged, the drainage simply splashes off the trough, then off the structural members and then down to the ground below. It was also noted that in order to make the current system operational, it would need to be cleaned and then cleaned weekly. The weekly cleaning explains why this is not done. The 'curtain' plan will not direct the drainage to the ~~sewage~~ system but merely protect the structural members as the water cascades past.
   - D. Discussed installing another type of joint but none seem any better. Roger Schultz recalled a similar project in Duluth and suggested contact be made with Don Stanley.
   - E. This work would include painting the inside of the End beams.
2. Median Repair
   - A. Questioned the need for two decks as it appears on the plan that the joint could be eliminated. Bridge is to investigate. [illegible]
   - B. Alternatives suggested:
     - a. As shown on sketch showing vertical walls constructed on existing curbs and covered by a connecting panel with a sloped top.
     - b. Remove deck between floor beams and replace with a single deck (no joint) and a J-rail.
     - c. Remove curbs and construct J-rail across joint.
   - C. Decided to have Bridge do further study.
3. Bird Guards
   - A. Need to limit size of opening to 1 inch to keep birds from nesting inside members.
   - B. Wire mesh or wire grid preferred over plastic plates.
   - C. The cost of similar work done on the East Grand Forks bridge was $9.00 per hole. If this cost can be used again, then consider doing all the holes on all the members, not just the upper and lower chords.
   - D. Metro Maintenance said they could do the installing. – Metro needs to decide if work will be done by maint or under contract.
4. Painting
   - A. Painting of truss members damaged by the water coming thru the center joint will

be done by a separate contract let in 1999.

B. The exception to this would be the painting done by the contractor doing the trough repair.

expansion joint

Comments (by E Wolhowe):

still need to protect floor beams

1. <u>Drain System</u>
   - A. The drainage system should be repaired and modified so that the drainage is once again carried to the sewage system. This can be done by relocating the trough to below the End Beams and sloping it adequately to make it self cleaning.
   - B. All of the finger joints should be modified to prevent water damage to substructure ? members. The joints on the end spans should also be included in the work.
2. <u>Median Repair</u>
   - A. Since the deck is in such poor condition near the joint, perhaps it would be best to replace the portion between the ~~floor beams~~ stringers. This has several advantages:
     - a. Eliminating the need to shotcrete the under side of the deck
     - b. The drainage problem could be more easily addressed.
     - c. The new J-barriers would take less room than the curbs.
     - d. It would involve more standard construction methods. The barriers could be slip formed.
     - e. The question of one deck versus two decks needs may not need to be answered.
3. <u>Bird Guard</u>

   — spring steel or

   - A. A wire grid using 0.125 inch diameter wires on one inch spacings cut to a rectangular shape of 12 inches by 24 inches would be relatively inexpensive to fabricate. Combining the grid with bent wire shapes similar to what was proposed by the fabricator would allow the grids to be snapped into place. Galvanizing would ensure longevity.
   - B. These could be manufactured and installed by either Maintenance or by private contractor. The grids can be manufactured by a number of Minnesota companies.
4. <u>General</u>
   - A. I sensed from the comments that the repairs should be more long term solutions as opposed to temporary fixes meant to last until the main repair tentatively scheduled in ten years.
   - B. Interrupting traffic is something that may be necessary in order to properly complete the project.
   - C. Adequate dollars are probably available for any of the options suggested.

Minnesota Department of Transportation

Memo

Office of Bridges and Structures
Mail Stop 610
Waters Edge
1500 W. Co. Rd. B2

Office Tel: 582-1100
Fax: 582-1110

Date: September 16, 1998

To: Gary Workman
Metro Division Office of Operations

From: Donald J. Flemming
State Bridge Engineer

Subject: BR 9340 - Cracks in Approach Span Girders

Bridge number 9340 carries TH 35W over the Mississippi River in Minneapolis. The bridge consists of a steel deck truss main span and continuous steel girder approach spans and was constructed in 1967. During the 1998 bridge safety inspection on September 7 - 14, 1998, Metro bridge inspectors noticed 13 crack locations 1" to 1.5" long in the 48" deep approach span girders at the top of the stiffener/diaphragm connection near Piers #3 and #4 at the south end of the bridge. The cracks are at the web toe of the web to top flange weld in the base metal and in 3 cases are turning down slightly into the web. This location is in a negative moment region and thus this location is in tension. See the attached plan sheet for a detailed location of the cracks.

After review in this office, it is recommended that Metro Bridge Maintenance drill out the ends of the cracks with a 1 1/2" core drill. The core samples should be submitted to Todd Niemann for analysis of the steel. During drilling it is recommended that ultrasonic testing be completed such that you are certain the end of the crack has been arrested. If the ends of the cracks can not be drilled out, we will recommend additional procedures or repairs to undertake.

It appears that these locations have potential for further cracking. We recommend that you perform close in-depth inspections of these areas on a six month interval, and keep a detailed weld/crack inspection log for these areas.

cc:
D. J. Flemming
G. D. Peterson
R. Noreen
E. Evans
J. Pirkl
R. Schultz
File Br 9340
J. R. Allen
P. Kivisto
T. Moravec
T. Niemann
M. Pribula
D. Hoff

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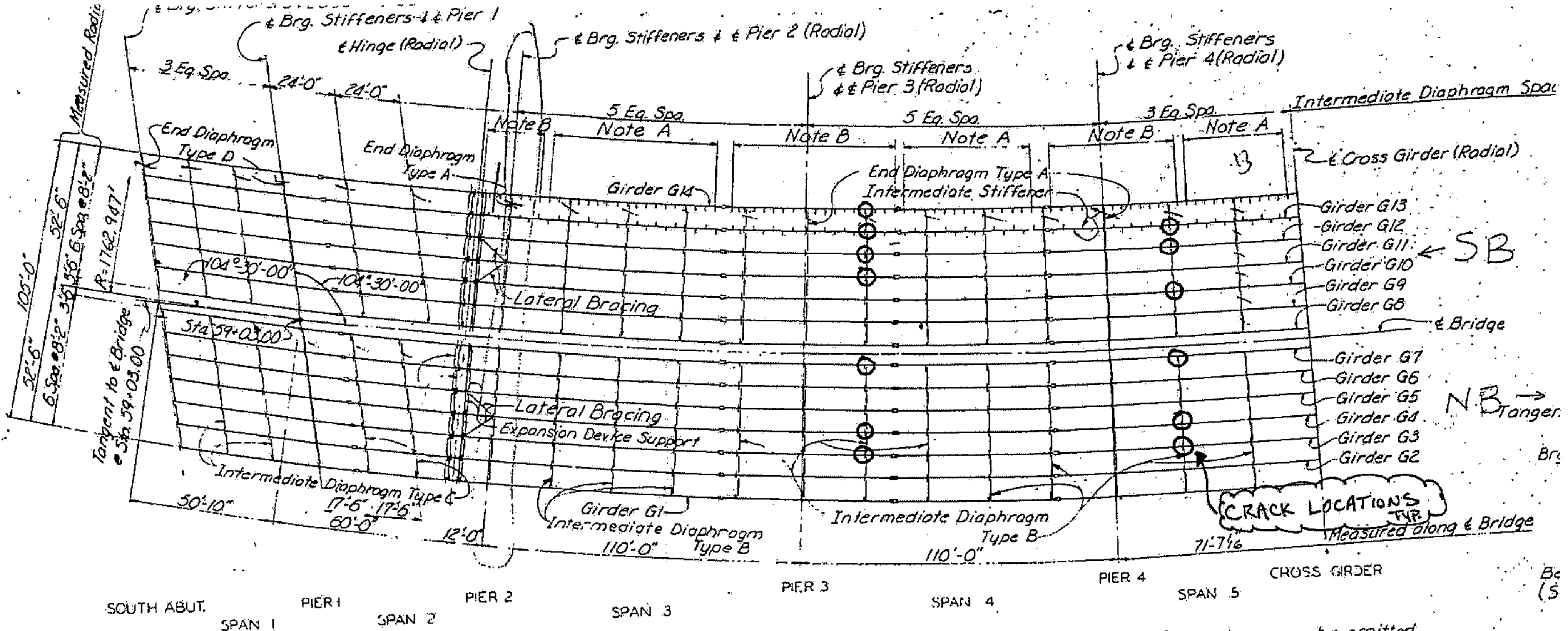
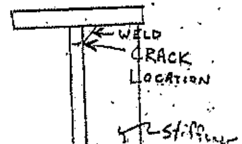


FRAMING PLAN

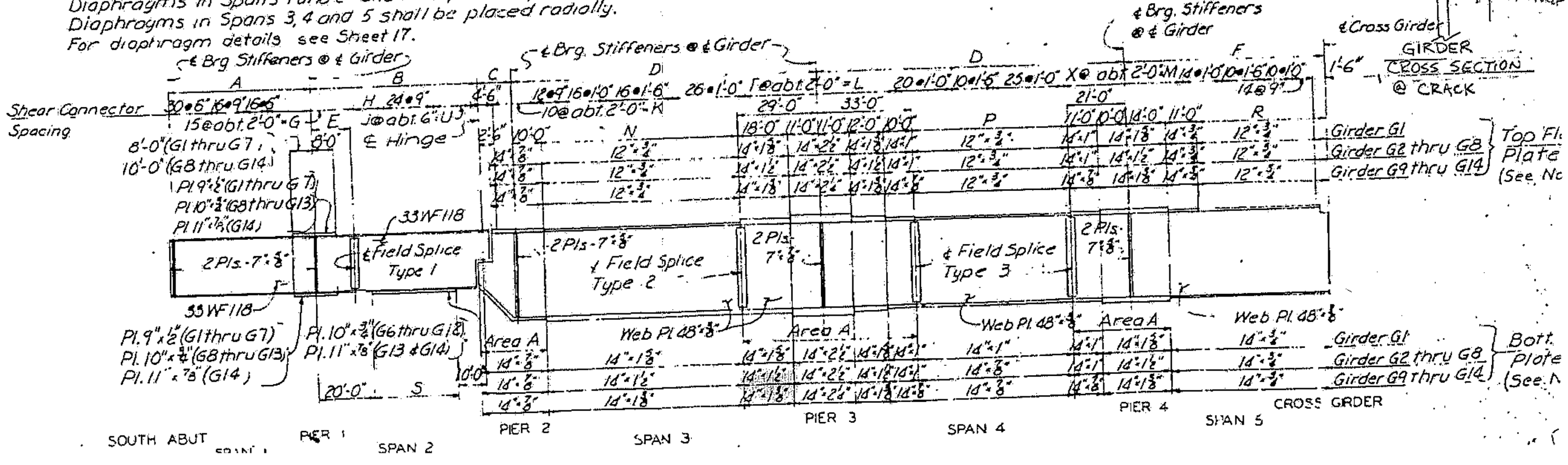
Note: Intermediate Stiffeners for Girders G1 and G14 shall be Pl. 4"×3/8".
Space as shown for G14 and normal to web.
Intermediate Stiffeners for Girders G2 thru G13 shall be Pl 4"×3/8".
Space as shown for G13 and normal to web.
Diaphragms in Spans 1 and 2 shall be placed parallel to Pier 1.
Diaphragms in Spans 3, 4 and 5 shall be placed radially.
For diaphragm details see Sheet 17.

Note: Diaphragms may be shifted slightly to clear Field Splices.

Note: Shear Connectors may be omitted over flange splice plates.



GIRDER CROSS SECTION @ CRACK



Final Report 2001-10

MINNESOTA DEPARTMENT OF TRANSPORTATION

Research

Fatigue Evaluation of the Deck Truss of Bridge 9340

Technical Report Documentation Page

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March 2001

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16. Abstract (Limit: 200 words)

This research project resulted in a new, accurate way to assess fatigue cracking on Bridge 9340 on I-35, which crosses the Mississippi River near downtown Minneapolis.

The research involved installation on both the main trusses and the floor truss to measure the live-load stress ranges. Researchers monitored the strain gages while trucks with known axle weights crossed the bridge under normal traffic. Researchers then developed two-and three-dimensional finite-element models of the bridge, and used the models to calculate the stress ranges throughout the deck truss.

The bridge's deck truss has not experienced fatigue cracking, but it has many poor fatigue details on the main truss and floor truss system. The research helped determine that the fatigue cracking of the deck truss is not likely, which means that the bridge should not have any problems with fatigue cracking in the foreseeable future.

As a result, Mn/DOT does not need to prematurely replace this bridge because of fatigue cracking, avoiding the high costs associated with such a large project.

The research also has implications for other bridges. The project verified that the use of strain gages at key locations combined with detailed analysis help predict the bridge's behavior. In addition, the instrumentation plan can be used in other similar bridges.

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FATIGUE EVALUATION OF THE DECK TRUSS OF BRIDGE 9340

Final Report

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EXECUTIVE SUMMARY

Bridge 9340 is a deck truss with steel multi-girder approach spans built in 1967 across the Mississippi River just east of downtown Minneapolis. The approach spans have exhibited several fatigue problems; primarily due to unanticipated out-of-plane distortion of the girders. Although fatigue cracking has not occurred in the deck truss, it has many poor fatigue details on the main truss and floor truss systems. Concern about fatigue cracking in the deck truss is heightened by a lack of redundancy in the main truss system. The detailed fatigue assessment in this report shows that fatigue cracking of the deck truss is not likely. Therefore, replacement of this bridge, and the associated very high cost, may be deferred.

Strain gages were installed on both the main trusses and the floor truss to measure the live-load stress ranges. The strain gages were monitored while trucks with known axle weights crossed the bridge and under normal traffic. Two- and three-dimensional finite-element models of the bridge were developed and calibrated based on the measured stress ranges. These finite-element models were used to calculate the stress ranges throughout the deck truss.

The peak stress ranges are less than the fatigue thresholds at all details. . Therefore, fatigue cracking is not expected during the remaining useful life of the bridge. The most critical details, i.e. the details with the greatest ratios of peak stress range to the fatigue threshold, were in the floor trusses. Therefore, if fatigue problems were to develop due to a future increase in loading, the cracking would manifest in a floor truss first. Cracks in the floor trusses should be readily detectable since the floor trusses are easy to inspect from the catwalk. In the event that the cracks propagate undetected, the bridge could most likely tolerate the loss of a floor truss without collapse, whereas the failure of one of the two main trusses would be more critical.

This research has implications for bridges other than 9340. The research verified that the behavior of this type of bridge can be deduced with a modest number of strain gages at key locations combined with detailed analyses. This instrumentation plan can be used in other similar bridges. Guidelines for service-load-level analyses of similar bridges are given to estimate typical fatigue stress ranges. Bridges may now be rated for fatigue in accordance with the new Load and Resistance Factor Rating procedures. Fatigue rating should be based on service-load-level analyses conducted according to these guidelines. If the results of preliminary assessment indicate that there is still concern about fatigue, the analyses should be calibrated with limited strain-gage testing.

CHAPTER 1

INTRODUCTION

PROBLEM STATEMENT

Bridge 9340 supports four lanes in each direction (eight lanes total) of I-35W across the Mississippi River just east of downtown Minneapolis. The Average Daily Traffic (ADT) is given as 15,000 in each direction, with ten percent trucks. Bridge 9340 consists of a deck truss and steel multi-girder approach spans built in 1967. The deck truss, shown in Figure 1, has a center span of 139 meters, north and south spans of 80.8 meters and cantilever spans of 11.6 and 10.9 meters. The bridge was designed using the 1961 American Association of State Highway Officials (AASHO) Standard Specifications [1]. At that time, unconservative fatigue design provisions were used. The American Association of State Highway and Transportation Officials (AASHTO) fatigue design rules were substantially improved as a result of research at Lehigh University in the 1970's [2,3].

The approach spans have exhibited several fatigue problems; primarily due to unanticipated out-of-plane distortion of the girders. Although fatigue cracking has not occurred in the deck truss, it has many poor fatigue details on the main truss and floor truss systems.

Stress ranges calculated using the lane load as live load are greater than fatigue thresholds for many of the details. The poor fatigue details in the deck truss include intermittent fillet welds, welded longitudinal stiffeners and welded attachments at diaphragms inside tension members. These details are classified as Category D and E with threshold stress ranges 48 and 31 MPa, respectively.

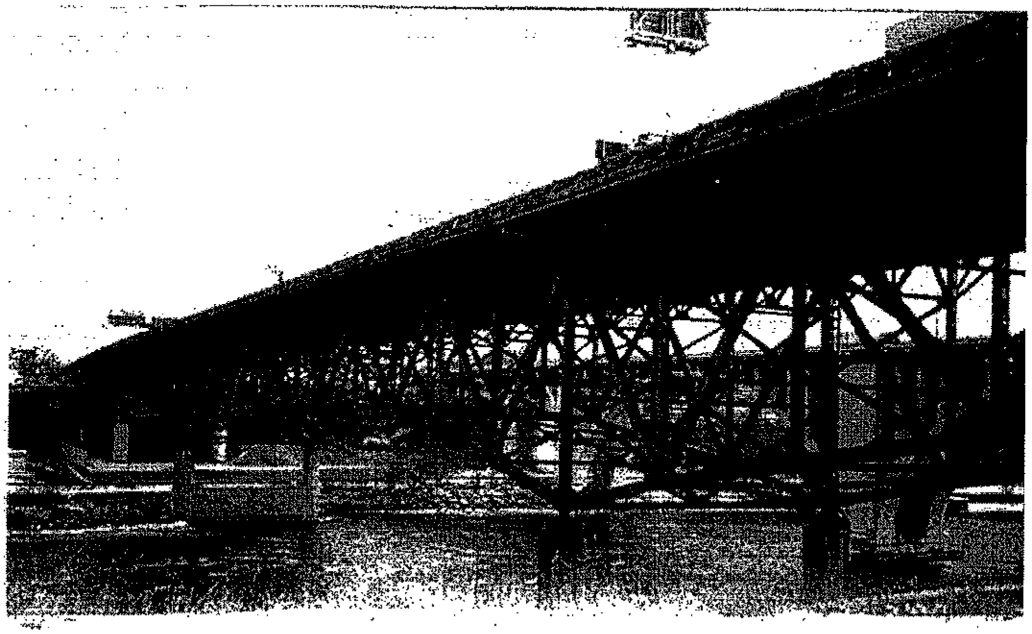


Figure 1: Bridge 9340

The design analysis, using the AASHTO lane load in all lanes, shows design-live-load stress ranges in the truss members much higher than these thresholds. Design-live-load stress ranges were greatest, up to 138 MPa, in members that experience load reversal as trucks pass from the outside spans onto the center span. The predicted average life at that stress range is between 20,000 and 40,000 cycles. With 15,000 trucks per day crossing the bridge in each direction, these details should have cracked soon after opening if the stress ranges were really this high.

The actual stress ranges can be determined by instrumenting the bridge with strain gages and monitoring strains under both a known load and open traffic. Fortunately, the actual stress ranges are much lower than these design live-load stress ranges. Consequently, the fatigue life is far longer than would be predicted based on the design-live-load stress ranges. The difference between actual and predicted stress ranges is the result of conservative assumptions made in the design process. The primary reason is that the traffic on the bridge is 90 percent cars and weighs a lot less than the lane loading, (9.34 kN/m). The lane loading is approximately equivalent to maximum legal 356 kN trucks spaced at about 38 meters apart.

The lane load may be appropriate for a few occurrences during the life when there are bumper-to-bumper trucks in all lanes, and the bridge should be designed to have sufficient strength to withstand this load. However, a few occurrences of loading of this magnitude would not have a significant effect on fatigue cracking. In fact, it has been shown that essentially infinite fatigue life is achieved in tests when fewer than 0.01 percent of stress ranges exceed the fatigue threshold [4]. Therefore, only loads that occur more frequently than 0.01 percent of the time have an effect on fatigue. If there are 15,000 significant load cycles (trucks) per day, any load that happens less frequently than daily is irrelevant as far as fatigue is concerned. In observing this bridge closely over the period of more than a year, the authors have never seen a condition where there were closely spaced trucks in each lane.

Other reasons that the actual live-load stress ranges are lower than design stress ranges include unanticipated structural behavior at service load levels. This unanticipated behavior includes composite action of the slab and the floor trusses and unintended partial fixity at the piers due to bearings that do not respond to live loads.

Concern about fatigue cracking in the deck truss is heightened by a lack of redundancy in the main truss system. Only two planes of the main trusses support the eight lanes of traffic. The truss is determinate and the joints are theoretically pinned. Therefore, if one member were severed by a fatigue crack, that plane of the main truss would, theoretically, collapse.

However, it is possible that collapse may not occur if this happened. Loads may be redistributed and joints may resist rotation and develop bending moments. If the fractured main truss deflected significantly the slab could prevent the complete collapse through catenary action. In any event, a fracture in one of the main trusses would require prolonged closure of the bridge and a major disruption.

OBJECTIVE OF RESEARCH

This research was conducted to:

1) characterize the actual statistical distribution of the stress ranges;
2) evaluate the potential for fatigue cracking in the deck truss and, if there is the potential for cracking, to estimate the remaining life;
3) recommend increased inspection or retrofitting, if necessary.

SCOPE OF REPORT

This report covers a literature review, inspection of the deck truss, field-testing and analysis of the deck truss, and discussion of the results. There is a brief discussion of previous problems with the approach spans, otherwise the approach spans are not discussed in detail.

The bridge was instrumented with strain gages, load tested with dump trucks with known axle weights in early October of 1999, and monitored on and off from March to August of 2000 to characterize the statistical distribution of the stress ranges. The measured strains were used to calibrate two and three-dimensional finite-element models of the bridge. These finite-element models were used to calculate the stress ranges throughout the deck truss. These stress ranges were compared to the thresholds for the particular details at each critical location. The most critical details, i.e. the details with the greatest ratios of peak stress range to the fatigue threshold, were identified. Recommendations are made for focused visual inspection.

CHAPTER 2

BACKGROUND

FATIGUE RESISTANCE

The American Association of State Highway and Transportation Officials (AASHTO) bridge design specifications (both the Standard Specifications and the Load and Resistance Factor Design (LRFD) Specifications) contain similar provisions for the fatigue design of welded details on steel bridges [5,6]. Welded and bolted details are designed based on the nominal stress range rather than the local "concentrated" stress at the weld detail. The nominal stress is usually obtained from standard design equations for bending and axial stress and does not include the effect of stress concentrations of welds and attachments. Since fatigue is typically only a serviceability problem, fatigue design is carried out using service loads. Although cracks can form in structures cycled in compression, they arrest and are not structurally significant. Therefore, only members or connections for which the stress cycle is at least partially in tension need to be assessed.

Both AASHTO bridge specifications are based on the same set of fatigue-resistance curves (S-N curves). The relationship used to represent the S-N curve is an exponential equation of the form:

$$N = A\,S^{-3} \qquad \text{(Eq. 1)}$$

or $\log N = \log A - 3 * \log S$

where: N = number of cycles to failure,

A = constant dependent on detail category

and S = applied constant amplitude stress range.

In design, the S-N curves give the allowable stress range for particular details for the specified life or number of cycles. In evaluation of existing bridges, these S-N curves can be used to estimate of the total number of cycles to fatigue failure for the actual measured stress range at a particular detail. The remaining life can be estimated by subtracting from the total cycles the cycles experienced in the past.

Each S-N curve represents a category of details. The AASHTO specifications present seven S-N curves for seven categories of weld details, Although E', in order of decreasing fatigue strength. Figure 2 shows the S-N curves for the detail categories C, D, E, and E'. (The categories A, B, and B' are usually not severe enough to cause cracking in service and therefore will not be discussed.) The S-N curves are based on a lower bound to a large number of full-scale fatigue test data with a 97.5 percent survival limit. Therefore, a detail optimally designed with these S-N curves and actually exposed to the stress ranges assumed in design has a 2.5 percent probability of cracking during the specified lifetime.

Figure 2 shows the fatigue threshold or constant amplitude fatigue limits (CAFL) for each category as horizontal dashed lines. When constant-amplitude tests are performed at stress ranges below the CAFL, noticeable cracking does not occur. For bridges in service, if almost all the stress ranges are below the CAFL, the fatigue life is considered essentially infinite. The CAFL for Category C, D and E is 69, 48, and 31 MPa, respectively.

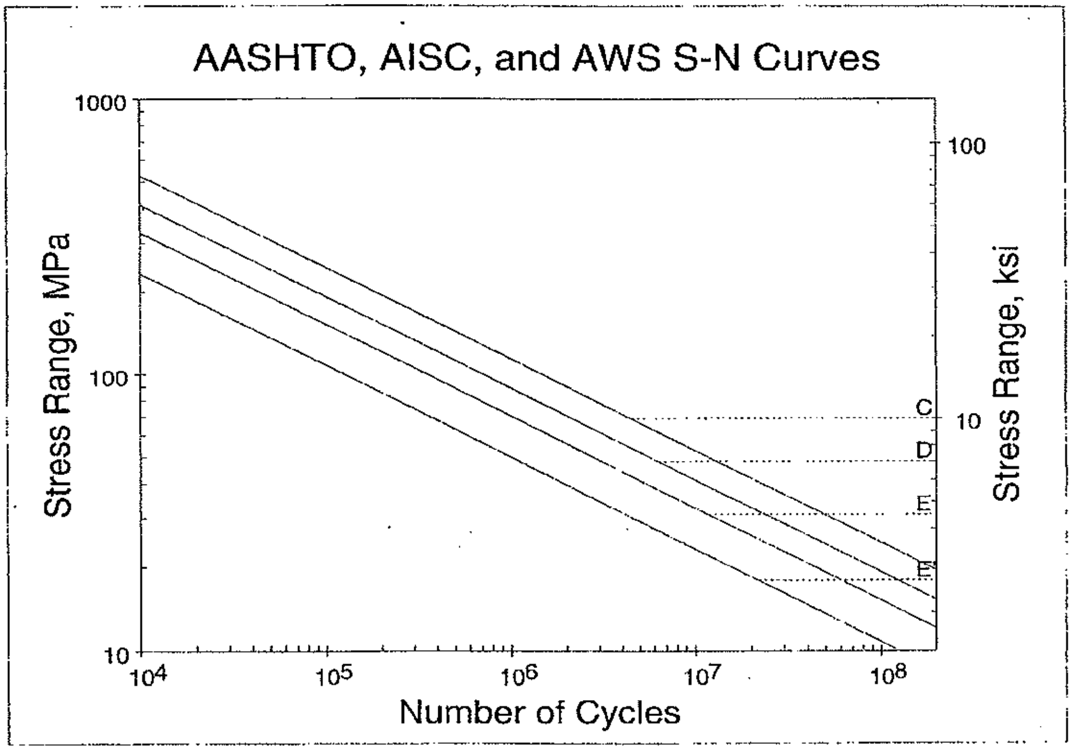


Figure 2: AASHTO Fatigue Resistance Curves

The critical details on Bridge 9340 are classified as non-load-bearing attachment details, i.e. attachments to structural members that do not carry significant load. With the exception of some special cases, these type of attachments are rated Category C if less than 51 mm long in the direction of the primary stress range, D if between 51 and 101 mm long, and E if greater than 101 mm long.

STRUCTURAL REDUNDANCY

In any structural system, loads are carried along a variety of simultaneous paths. The existence of these redundant load paths in a bridge ensures reliable structural behavior in instances of damage to some of the structural elements [7]. However, is there is no redundancy, failure of one member may cause the entire structure to collapse.

The Committee on Redundancy of Flexural Systems conducted a survey of steel highway and railroad bridges reported suffering distress in main load carrying members. Twenty-nine states and six railroad companies responded. A total of 96 structures were reported as suffering some distress. The survey found that most failures were related to connections, nearly all of which were welded. The data collected on bridges that suffered damage indicate that few steel bridges collapse if redundancy is present. The reported collapses involved trusses with essentially no redundancy [7].

In another study, Ressler and Daniels [8] found that the number of fatigue-sensitive details present in the structure significantly affected the system reliability of a nonredundant bridge. For example, the reliability of a span with 20 Category E' details was found to be substantially lower than the reliability associated with a single E' detail.

CALCULATED AND ACTUAL BRIDGE RESPONSE

Many studies have shown that the simplified calculations used to predict stresses in bridge members are inherently conservative [9,10,11,12,13,14,15,16]. As a result, the calculated stresses are often much higher than the actual service stresses and the fatigue assessment is unnecessarily pessimistic. From the form of Equation 1, it is clear that a small change in the estimate of the stress range results in a much larger change in the life, i.e. the effect is cubed. For example, if the stress range is conservative by only 20 percent, the computed life will be 42 percent too low.

The design calculations, load models, and the level of conservatism are appropriate for strength design where there is great uncertainty in the maximum lifetime loads. However, for fatigue evaluation of an existing bridge, an accurate estimate of the typical everyday stress ranges is required. Therefore, for fatigue evaluation of existing bridges, a more appropriate set of analysis assumptions is required and it is best if the analysis is "calibrated" relative to measured strain data.

In a large bridge, service live-load stress ranges typically do not exceed 20 MPa [10]. The stress ranges are small because the dimensions of the members of a large bridge are typically governed by dead loads and strength design considerations. Since the strength design must account for a single worst-case loading scenario over the life of the bridge, conservative load models are used (large factors of safety).

In addition to conservative load models, assumptions in analysis can also often lead to actual stresses being far lower than predicted stresses. An example of the effect of these assumptions is illustrated in a study of U.S. Highway 69 in Oklahoma crossing the South Canadian River [11]. Concerns of fatigue damage arose when poor welding techniques had been used in the widening of the bridge. Preliminary analyses had shown that stress ranges could exceed allowable stress ranges at over 100 locations on the bridge. However, when the bridge was instrumented with strain gages and monitored under known loads and normal traffic the largest measured stress range was found to be 27 percent of the allowable stress range, far below predicted.

In another study, fatigue concerns arose due to a considerable amount of corrosion on the floorbeams of Bridge 4654 in Minnesota [12]. The bridge was instrumented with strain gages and monitored under known loads and normal traffic. Here, measured stress ranges ranged from 65 to 85 percent of those predicted by analysis.

These disparities are due to the fact that analytical models often use assumptions that conservatively neglect ways in which the structure resists load. Sometimes the structural behavior could never have been predicted in design. For example, Dexter and Fisher [13] discuss the results of field tests on an adjacent pair of railroad bridges. It was found that ballast had fallen in the narrow space between the girders forcing the adjacent bridges to deflect together as if joined. This behavior distributed load from the bridge with the train on it to the other bridge, resulting is stress ranges less than half of predicted, especially in the exterior girder nearest the adjacent bridge.

In a study performed by Brudette et al. [14], more than 50 years of bridge test data were collected and examined to determine specific load-resisting mechanisms that are typically ignored in design or evaluation. The study revealed that lower stress ranges in a structure can be attributed to unintended composite action, contributions from non-structural elements such as parapets, unintended partial end fixity at abutments, and direct transfer of load through the slab to the supports.

- Composite Action: Bridges with shear connectors at the slab-girder interface typically display full composite action. However, some composite action is seen in the absence of shear connectors, resulting in lower stresses in the structure. At service load levels, composite action is even effective in resisting negative moment.

- Partial End Fixity: Often, bridges and bridge members are designed to behave as if they are simply supported. However, these supports usually do not behave as intended. Partial fixity in the end connections on beams causes a lower positive moment that would be obtained from the simply supported beam model. Bearings that are meant to be a roller boundary condition, or fixing the displacement in the vertical direction while allowing longitudinal movement, can become frozen due to corrosion, extremely cold weather or poor design. This can change the response of a bridge subjected to loading by introducing horizontal resistance where it was not intended.

- Transfer of Load Through Slab: Load distribution refers to the lateral distribution of load to longitudinal supporting elements. The slab typically does a much better job of

> spreading the load than anticipated in design. The lateral distribution is more favorable than assumed, and there is significant spreading of the load longitudinally, which is not even counted on in design. Often, part of the load is distributed directly to the supports bypassing the longitudinal stringers or girders.

In a similar study, the Ministry of Transportation of Ontario conducted a program of bridge testing that included more than 225 bridges over a period of many years [15]. The study revealed that in every bridge test there were surprising results that were not expected the most common of which was a bridge's ability to sustain much larger loads that their estimated capacities.

Specifically, the following observations were made in the testing of steel truss bridges.

- The stringers of the floor system sustained a large share of the tensile force thus reducing the strains felt by the chord in contact with the floor system.

- Again, composite action in non-composite systems was shown to exist. However, subsequent tests showed that this composite action breaks down completely as the failure limit state for the girder is approached [16].

Although these unintended structural behaviors are nearly impossible to model, they often combine to produce actual stresses well below those calculated by simplified design calculations or even finite-element analysis of the idealized structure [10].

To calibrate the analysis, the results are compared to the measured response and changes are made in the model until the results agree reasonably well with the measurements. Strain gage data are typically acquired on several bridge members where maximum stress ranges are expected to occur. Measurements are typically made while a truck or multiple trucks of known weight and configuration traverse the bridge in the absence of other traffic. The results from this test eliminate uncertainty in the load and isolate the part of the error due to the analysis. The analysis is linear, so once it is calibrated it can be used to predict the stress ranges from the maximum legal load, permit loads, or groups of trucks as appropriate for the fatigue analysis.

Often, some measurements are also made in open traffic for several days to characterize the statistical distribution of the topical stress ranges, which is proportional to the statistical distribution of the truck axle weights or total gross weights. Some members (e.g. floorbeams) are loaded by each truck axle. The members of a large trusses such as bridge 9340 do not respond to each axle load separately but rather respond with one cycle associated with the gross vehicle weight.) In highway bridges, a two or three day period seems to be satisfactory to capture a realistic representation of stress ranges and their respective frequencies [17]. It is best if the data collection system is left running continuously to capture both day and night traffic with both full and empty trucks. It may also be wise to capture seasonal changes in traffic and the response of the bridge by taking data in two or three day periods at various times of the year.

Once strain data at known locations has been accumulated, a finite element model of the bridge is generated. The model must be created with as much accuracy as possible before calibration begins. The model is then calibrated by adjusting: 1) the amount of composite action in members near the deck; 2) the fixity of the supports; and, 3) the distribution of loads on the deck; until calculated strains match measured strains. Once the model is calibrated by a limited number of measurements, it can be used to calculate strains throughout the bridge.

FATIGUE EVALUATION PROCEDURES

An actual service load history is likely to consist of cycles with a variety of different load ranges, i.e., variable-amplitude loading [4]. However, the S-N curves shown in Figure 2 are based on constant-amplitude loading. There is an accepted procedure for converting variable stress ranges to an equivalent constant-amplitude stress range with the same number of cycles. This procedure is based on the damage summation rule jointly credited to Palmgren and Miner (referred to as Miner's rule) [18]. If the slope of the S-N curve is equal to three, then the relative damage of stress ranges is proportional to the cube of stress range. Therefore, the effective stress range is equal to the cube root of the mean cube of the stress ranges [19].

$$S_{re} = (\Sigma\, p_i\, S_{ri}^{\ 3})^{1/3} \quad \text{(Eq. 2)}$$

The effective stress range is used the same way as the constant amplitude stress range, i.e. the S-N curve is entered with the value of the effective stress range and the intersection with the S-N curve defines the number of cycles in the total life, assuming that the effective stress range is relatively constant over the life. This procedure works fairly well in the shorter life regime where the effective stress range is much larger than the fatigue threshold.

When the effective stress range is on the order of the fatigue threshold or less, dealing with variable stress ranges becomes more complicated. Figure 3 shows the lower part of an S-N curve with three possible variable stress-range distributions superposed [20]. The effective stress range is shown as S_{re} in this figure and is used the same way as a constant-amplitude stress range with the S-N curves in the finite-life regime (Case 1 and Case 2).

For Case 3 in Figure 3, essentially all the stress ranges are less than the CAFL. In this case, long-life variable-amplitude fatigue tests on full-scale girders with welded details show that if less than one in 10,000 cycles exceed the CAFL, then essentially infinite life is obtained [4]. This phenomenon is the basis of what is called the "infinite-life" approach, which is incorporated in the AASHTO LRFD specifications [5].

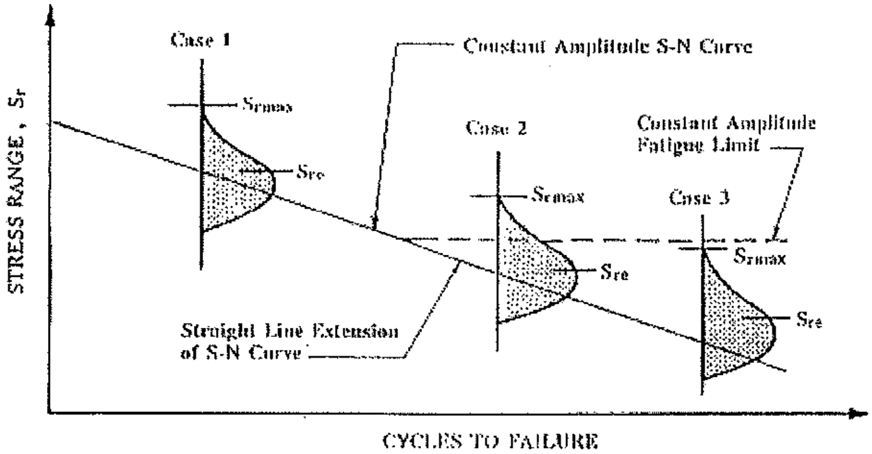


Figure 3: Possible Cases of S_{re} and S_{rmax} in Relation to the CAFL

Guide Specifications for the Fatigue Evaluation of Existing Bridges

Fatigue evaluation procedures for existing steel bridges were developed in a project sponsored by the National Cooperative Highway Research Program (NCHRP) that resulted in Report 299 [10]. This study was done to develop practical procedures that accurately reflect the actual fatigue conditions in steel bridges, which could be applied for evaluation of existing bridges or design of new bridges. The procedures utilized information gained from several years of research on variable-amplitude fatigue behavior, high-cycle, long-life fatigue behavior, actual traffic loadings, load distribution, and assessment of material properties and structural conditions.

In NCHRP 299, it is stated that fatigue checks should be based on typical conditions that occur in the structure, rather then the worst conditions expected to occur as in a strength design. The procedure begins with determination of a nominal stress range for the truck traffic crossing the bridge. This stress range is then compared to the S-N curve for the type of detail found on the structure to determine the number of cycles to failure. Then the life of the detail can be calculated using current estimated truck volume, the present age of the bridge, and the number of load cycles for each truck passage.

NCHRP report 299 provides the following equation to calculate fatigue life for an estimated lifetime average daily truck volume based on stress range measurements taken at the bridge site.

$$Y_f = [(f\,K \times 10^6) / (T_a\,C\,(R_s\,S_{re})^b)] - a \qquad \text{(Eq. 3)}$$

where,

Y_f = remaining fatigue life in years

S_{re} = effective stress range

R_s = reliability factor

C = stress cycles per truck passage

K, b, and f = fatigue curve constants

T_a = estimated lifetime average daily truck volume

a = present age of bridge in years

Further discussion of these variables follows.

Effective Stress Range

The effective stress range is calculated from Equation 2 using stress-range histograms obtained from field measurements on the bridge under normal traffic. The stress range may be computed from an analysis where the loading is the cube root of the mean cube of the gross-vehicle-weight histogram. Alternatively, an HS-15 truck (HS-20 loading multiplied by 0.75) may be used to calculate the effective stress range if measurements are not available.

Reliability Factor (R_s)

The reliability is used when calculating the remaining safe life. It is used to ensure that the actual life will exceed the safe life to a desired probability. When calculating the remaining mean life, the reliability factor is 1.0. When calculating the remaining safe life, multiply the computed stress range S_{re} by a reliability factor:

$$R_s = R_{so} (F_{s1}) (F_{s2}) (F_{s3}) \qquad \text{(Eq. 4)}$$

where,

R_s = reliability factor associated with calculation of stress range

R_{so} = basic reliability factor

= 1.35 for redundant members

= 1.75 for nonredundant members

F_{s1} = 0.85 if effective stress range calculated from stress range histograms obtained from field measurements

= 1.0 if effective stress range calculated by other methods

F_{s2} = 0.95 if loads used in computations are for site-specific weigh-in-motion measurements

= 1.0 if the AASHTO fatigue truck is used

F_{s3} = 0.96 if rigorous analytical method is used to determine load distribution

= 1.0 if approximate method based on parametric studies is used

Stress Cycles Per Truck Passage (C)

A single truck traveling over a bridge can often have a complex response resulting in more than one stress cycle per truck passage. Whereas most main members feel just one cycle per truck, transverse members near the deck may feel each axle load as it passes. The number of stress cycles per truck passage, C, has been determined for various types of bridge members. The number of stress cycles per passage for Bridge 9340, a deck truss bridge, is 1.0.

Fatigue Curve Constants (K, b and f)

The equation for the S-N curves was given in Equation 1. The parameter b is the exponent and is 3.0 for the AASHTO S-N curves. For convenience in calculating the remaining life in years, the detail constant K is used (Eq. 5).

$$K = A / [365 \times 10^6] \qquad \text{(Eq. 5)}$$

Where A was defined for Equation 1. There is considerable scatter in the fatigue data on which Eq. 4 is based. It is normally assumed that the scatter in stress range values follows a log-normal statistical distribution for a given N. Consequently, allowable nominal stress ranges are usually defined two-standard deviations below the mean stress ranges. Since the mean and allowable S-N curves for a given detail are assumed to be parallel on a log-log plot, the ratio of stress ranges for the two curves is the same at all cyclic lives [10].

The constant f is used to modify the constant K to reflect the mean remaining life rather that the safe remaining life. The constant f equals the ratio of the mean-life curve intercept, A', to the safe-life curve intercept, A. For categories B through E', the ratio of mean to allowable stress range does not vary greatly and averages 1.243. Because of the power of 3 in the S-N curve, the corresponding ratio of mean to safe lives is equal to 1.243 cubed, or 1.92. Thus, the value of f is taken as 2.0 while calculating mean life. If the safe life is being calculated, f equals 1.0 [10].

Lifetime Average Daily Truck Volume (T_a)

The present average daily truck volume in the outer lane, T, can be calculated from the ADT at the site as follows:

$$T = (ADT)\,F_T\,F_L \qquad \text{(Eq. 6)}$$

where

ADT = present average daily traffic volume in both directions

F_T = fraction of trucks in the traffic

F_L = fraction of trucks in the outer lane

The ADT can be determined by doing a traffic count or may be obtained from Department of Transportation data for the location of interest. The fraction of trucks in the traffic is suggested to be 0.20 for rural interstate highways, 0.15 for rural highways and urban interstate highways, and 0.10 for urban highways. The fraction of trucks in the outer lane may be determined from Table 1.

Table 1: Fraction of Trucks in Outer Lane [10]

Number of Lanes	2-Way Traffic	1-Way Traffic
1	-	1.00
2	0.60	0.85
3	0.50	0.80
4	0.45	0.80
5	0.45	0.80
6 or more	0.40	0.80

Using the calculated present average daily truck volume in the outer lane, T, the annual growth rate, g, the present age of the bridge, a, and Figure 4, the lifetime average daily truck volume in the outer lane can be determined. The annual growth rate can be determined from Table 2. This table lists annual growth rates estimated from Annual Average Daily Traffic (AADT) data taken at counting stations throughout the United States between the years 1938 and 1985.

Table 2: Observed Average Daily Traffic Growth Rates [10]

Type of Highway	Rural or Urban	Growth Rate %
Interstate	Rural	4.45
	Urban	4.98
U.S Route	Rural	2.87
	Urban	4.19
State Route	Rural	3.77
	Urban	3.27

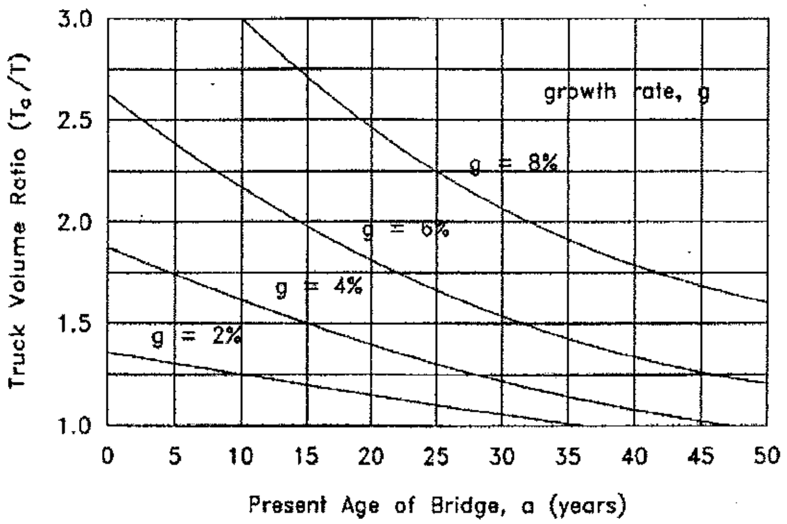


Figure 4: Truck Volume Ratio (T_a / T) [10]

CHAPTER 3

DESCRIPTION, DESIGN, AND HISTORY OF BRIDGE 9340

DESCRIPTION OF BRIDGE

Bridge 9340 carries I-35W over the Mississippi River just east of downtown Minneapolis. Constructed in 1967, the 581 meter long bridge has 14 spans. The south approach spans (Spans #1-#5) are steel multi-beam. The main spans (Spans #6-8) consist of a steel deck truss. The north approach spans include both steel multi-beam (Spans #9-#11) and concrete slab span (Spans #12-14).

There are two steel deck trusses. Most of the truss members are comprised of built-up plates (riveted) while some of the diagonal and vertical members are rolled I-beams. The connections include both rivets and bolts. The truss members have numerous poor welding details. Recent inspection reports have noted corrosion at the floorbeam and sway brace connections, and pack rust forming between connection plates [21].

The bridge deck above the deck truss is 32.9 meters wide from gutter to gutter. Three continuous spans cross the river, the north and south span measuring 80.8 meters and central span measuring 139 meters. Three of the four piers supporting the river crossing have two huge geared rollernest bearing assemblies while the second pier from the north is a fixed connection. These truss bearings have moderate corrosion [21].

The two main trusses have an 11.6-meter cantilever at the north and south ends. There are also 27 floor trusses, spaced at 11.6 meters. These floor trusses frame into the vertical members of the main truss. The floor trusses consist of WF-shape members and have a 4.97-meter cantilever at each end.

The built-up box sections have attachments measuring 8.9 cm square welded to diaphragms at the interior of all tension members (Figure 5). There are also intermittent fillet welds at the interior of all box sections. These are both Category D details. The floor truss members have longitudinal stiffeners measuring 30.5 cm, which would be considered a Category E detail (Figure 6).

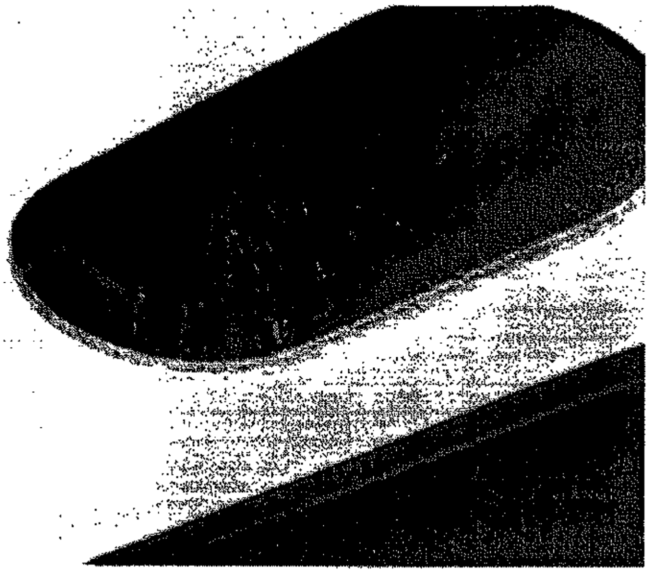


Figure 5: Welded Attachment at Interior of Box Section of Main Truss

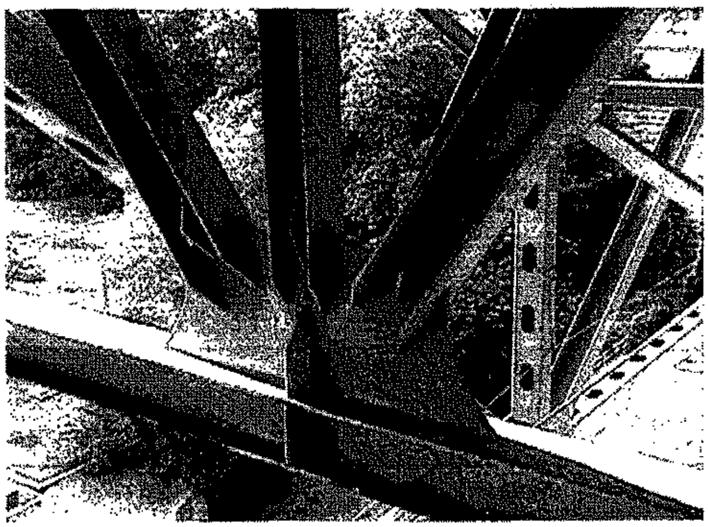


Figure 6: Longitudinal Stiffeners at Floor Truss Connections

BRIDGE DESIGN

Bridge 9340 was designed using the 1961 AASHO specifications [1]. This code utilizes a uniform lane load and a truck for live load. The uniform live load consists of a 9.34 kN per linear meter of load lane and a concentrated load of 11.6 kN for shear. The truck load uses HS-20 truck which has a front axle load of 35.6 kN followed 4.27 meters behind by a 142.3 kN axle followed anywhere from 4.27 to 9.14 meters behind by another 142.3 kN axle. The wheels of the HS-20 truck are spaced 1.83 meters apart. All loads are patterned for maximum effect. Resulting load effects are reduced by ten percent if the maximum load effect is produced by loading three lanes, and by 25 percent if four or more lanes are loaded.

The design of the main trusses utilized the uniform lane loads. All four lanes above the truss being designed and the three nearest lanes opposite the centerline were loaded. Using a tributary length of 11.6 meters for each panel point of the truss, this loading results in a concentrated load of 367 kN and a uniform load of 343.8 kN. The south cantilever of the main truss has a tributary length of 16.6 meters and thus a uniform design load of 489.3 kN. The north cantilever of the main truss is designed using four loaded lanes and a tributary length of 25.5 meters and does not consider the effect of the floor truss cantilever as most of the tributary length is outside of the truss region. This results in a uniform design load for the north cantilever of 716.2 kN.

Load is distributed from the floor system to the floor truss through the stringers. The stringers are continuous over four spans from panel points 0 to 8 and 8' to 0' and continuous over six spans from panel points 8 to 8'. The internal reactions of the four span continuous stringers were found under a HS-20 truck loading and applied to the floor truss in design. Each axle is spaced at 4.27 meters in the design. The HS-20 trucks were then placed in the lanes either shifted toward the curb or the centerline of the roadway to get the maximum load possible on each stringer and to each node in the floor truss. An impact factor of 30 percent was included in the design.

HISTORY OF BRIDGE

Bridge 9340 was built in 1967. While there have been no structural problems with the deck truss, there have been recent problems with the approach spans on both ends of the bridge. In 1997, cracks were discovered in the cross girder at the end of the approach spans. A small section of the end of each main truss is attached to bearings at reinforced openings in the cross girder. It appeared that resistance to movement of the bearings was causing significant out-of-plane forces and associated distortion on the cross girder, leading to cracks forming at the termination of the stiffeners reinforcing the opening. The cross-girder was retrofit by drilling holes at the tips of the cracks and adding struts from the reinforcing stiffeners back to the girders to reduce the distortion. This retrofit has been successful so far in preventing further crack propagation.

One year later, web gap cracking was discovered at the top of diaphragm attachment plates where they were not welded to the top flange in negative moment areas of the continuous girders. One crack had grown nearly the full depth of one of the girders. This girder was retrofit by drilling a large hole at the crack tips and bolting large web doubler plates to reinforce the cracked area. Other smaller cracks discovered at that time had holes drilled at their ends. Additional holes were drilled in the connection plates and the diaphragms in the negative moment areas were placed much lower to increase the flexibility. The bolts were replaced with the next size lower and were only tightened to a snug condition to allow some slip. Strain gages were placed in the web gap regions of the girder webs to read the values of strain before and after the retrofit. Before the retrofit, stress ranges were large enough to explain the cracking. These stress ranges were reduced by more than 50 percent by the retrofit to levels that would not be expected to cause further cracking [22].

The presence of birds has caused some concern for the deck truss. The main truss is constructed of built-up box sections that in the past have housed many pigeons. It is known that guano can have highly corrosive effects on steel and that extreme corrosion can lead to fatigue problems. Therefore, in the summer of 1999 when the bridge was painted, the access holes of the box sections were fitted with covers to prevent birds from entering the truss members.

CHAPTER 4

FIELD TEST PROCEDURES

LOCATION OF STRAIN GAGES

Due to the ease of access provided by the transverse catwalk, panel point 10 was chosen for the placement of strain gages. This is located in the negative moment region of the continuous three span truss, therefore the lower chord would be expected to be in compression and the upper chord would be in tension under loading.

Six gages were put on each of the east and west main trusses and the floor truss. On the main trusses, a gage was placed on the interior and exterior of the members at mid-depth, to avoid any bending effects. An upper chord (U8-U10), a diagonal (L9-U10), and a lower chord (L9-L11) were instrumented. These members are identified in Figure 7 as the bold members next to panel point 10. The gages were placed at least one section depth away from the connection to avoid stress concentrations.

The floor truss has gages on the east side of the centerline. A gage was placed on the upper and lower flanges of an upper chord (U5-U6), a diagonal (U5-L7), and a lower chord (L4-L7) (Figure 8). These gages were also placed at least one section depth away from the connection to avoid stress concentrations. Figure 9 shows the gages in place on the exterior of the east truss on the upper chord and the diagonal.

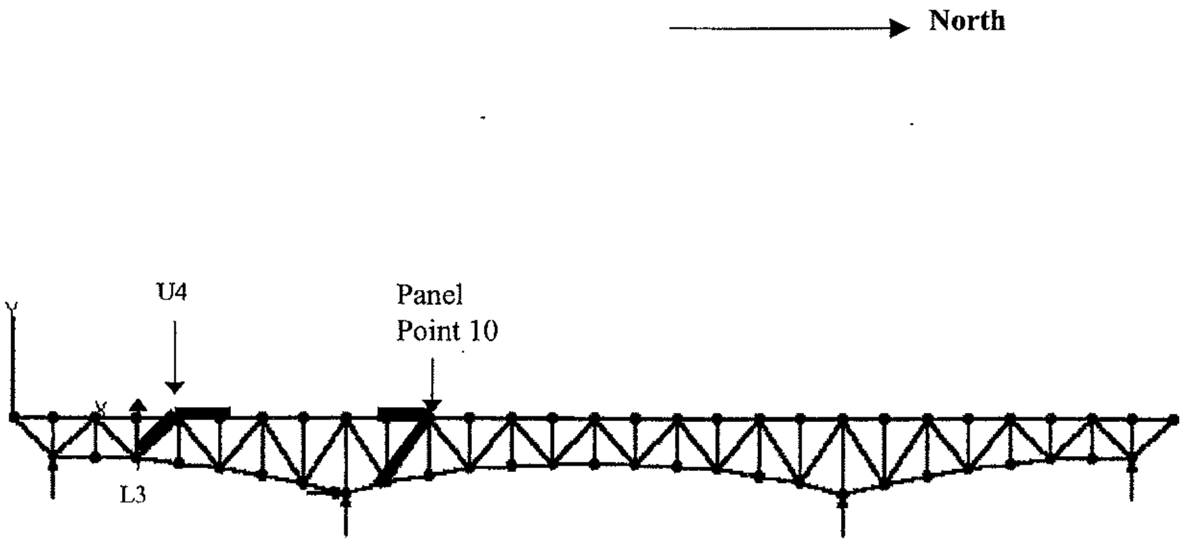


Figure 7: Gaged Locations on the Main Truss

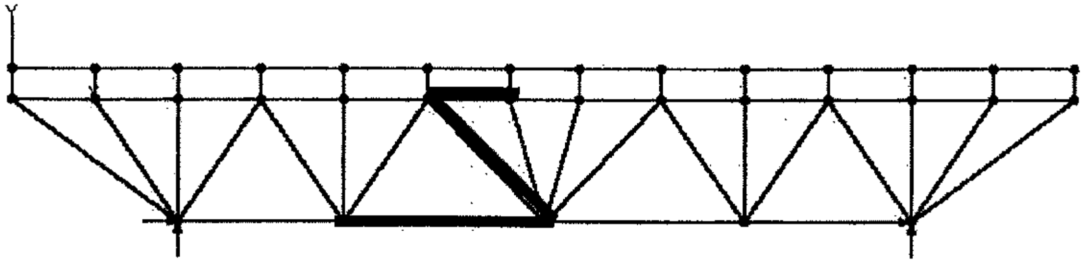


Figure 8: Gaged Locations on the Floor Truss

Figure 9: Gaged Upper Chord and Diagonal on Exterior of East Truss

A reversal member (U4-U6) was instrumented, i.e. a member that experiences stress in one direction from approaching trucks and stress in the other direction when the trucks pass over the pier. A member with very high design stress ranges in tension (L3-U4) was also instrumented. These members were located on the south side of the west truss and are designated in bold in Figure 7. Gages were attached to the interior and exterior of these members at mid-depth, also at least one section depth away from the connection.

The wires leading from the gages ran to a central point on the transverse catwalk where they were wired into a data acquisition system housed in a locked electrical box. The box was attached to the catwalk railing using U-bolts. This set up is shown in Figure10.

Figure 10: Data Recording Station on Catwalk of Bridge

TEST DESCRIPTIONS

Controlled Load Tests

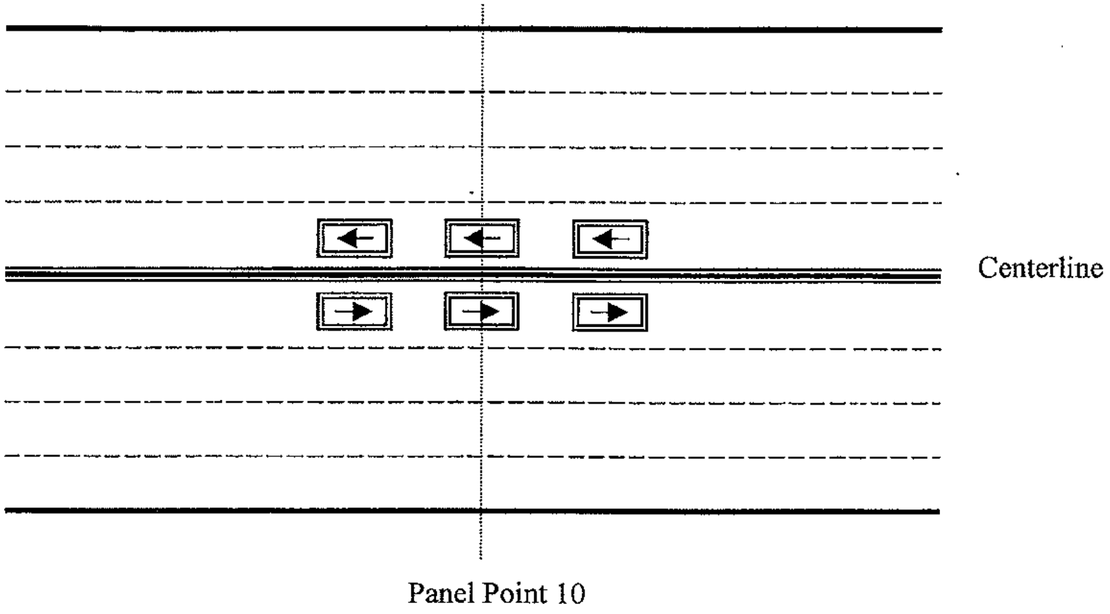
Over the course of two days, four types of tests were conducted. All tests took place after midnight to minimize interference with traffic. Nine Minnesota Department of Transportation (Mn/DOT) tandem-axle dump trucks, each with a gross vehicle weight 227 kN, were used. Strains for this test were recorded for the gages at panel point 10 only, not at the reversal and high-tension-stress members.

Test 1 consisted of two groups of three trucks, with each set driving in a single file line in the left lane in each direction of traffic. This test required that the left lanes were closed. This was done with signing and traffic control provided by Mn/DOT. To represent static conditions each line of trucks were traveling at a crawling speed. The trucks were to follow each other as closely as possible. Optimally, the middle trucks in each group were to meet simultaneously at panel point 10, directly above the instrumented floor truss (Figure 11a).

Test 2 consisted of running all nine trucks in a 3 x 3 formation. The trucks were to travel as close as possible to each other while maintaining highway speeds. Three round trips were made, i.e. three trips in the southbound direction and three in the northbound direction. No lane closures were required for this test. This test set up is shown in Figure11b.

Test 3 consisted of using all nine trucks and running them in a single file line as close as possible to each other (Figure 11c). This was done in the third lane from the centerline as it was the lane most directly over the main truss. The test was run at highway speeds with no lane closures.

In Test 4, the trucks ran side-by-side in groups of three. All nine trucks were used with each group of three following the preceding group by no less than one-half mile. This was done to ensure that only one group of three would be on the bridge at a time. This test was also run at highway speeds. No lane closures were required for this test. The set-up is shown in Figure 11d.



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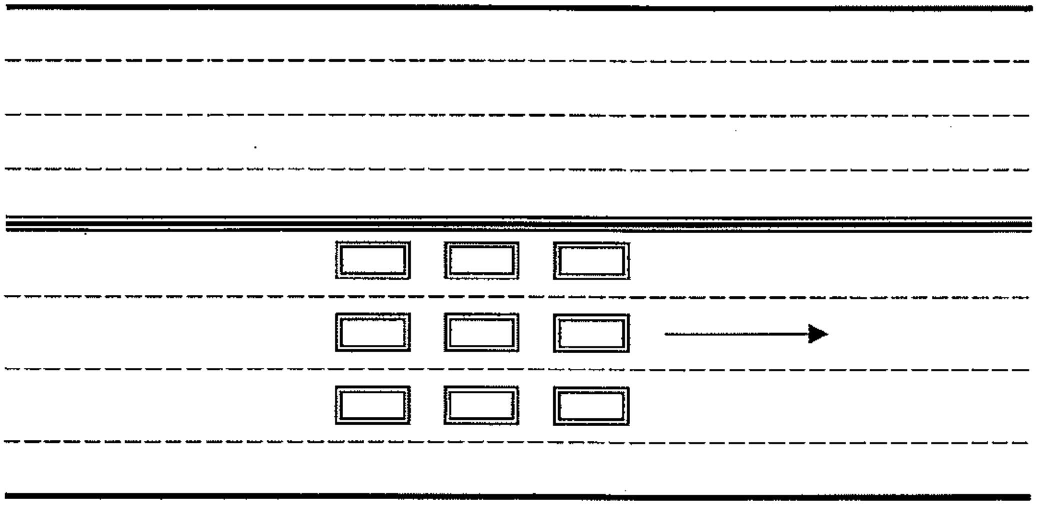


B

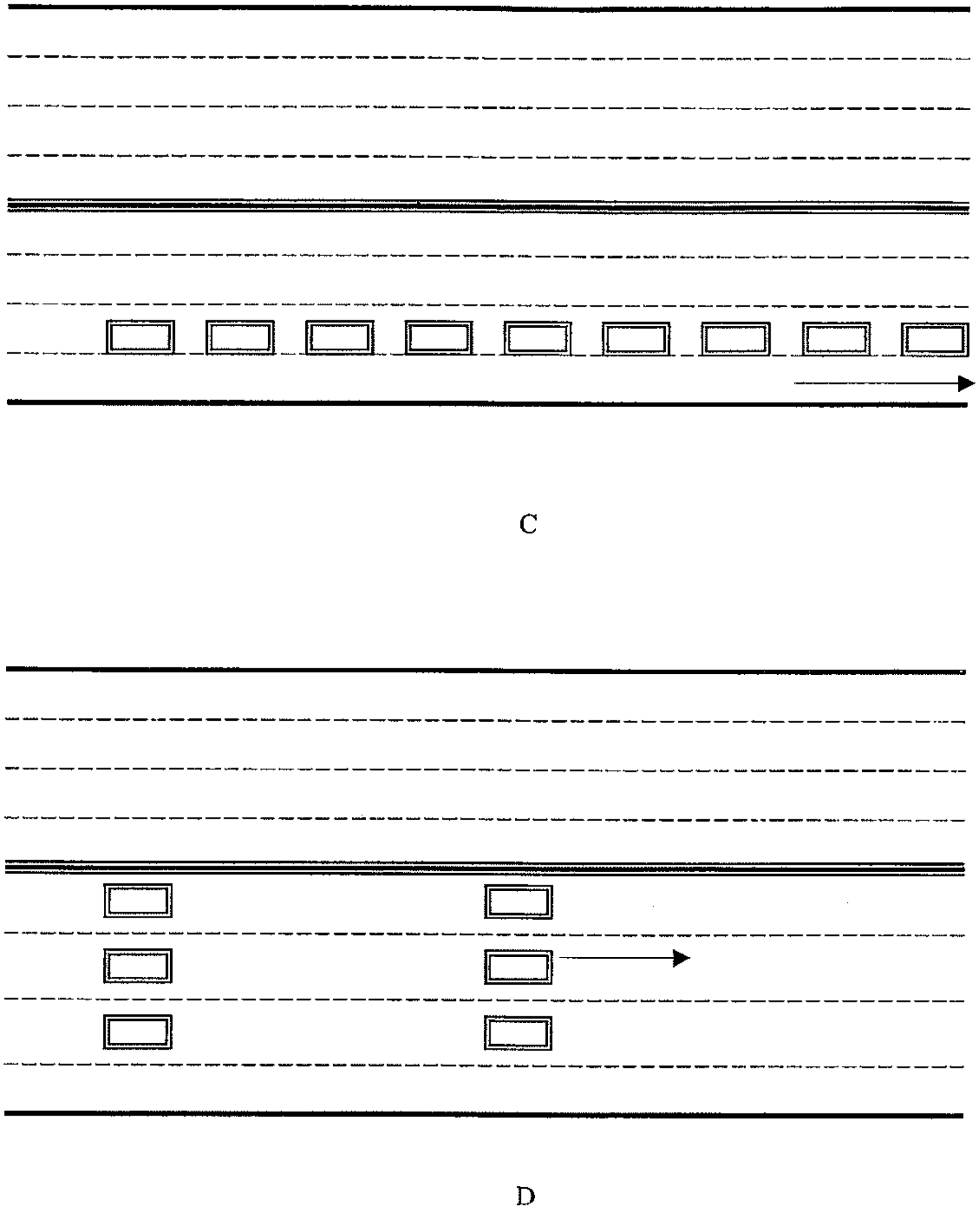


Figure 11: Test Set-ups

Open Traffic Tests

Data were also collected during a period of several months on the main and floor trusses to determine typical bridge stress ranges. Both triggered and constant data collection was used. However, triggered data collection was used most to avoid collecting hundreds of megabytes of data that did not show any stress events. This was done for all the gages at panel point 10.

Triggered data collection refers to a method in which the data acquisition system is constantly scanning the gages but does not record anything until strain in a chosen gage exceeds a predetermined limit. The data collection software limited the number of gages one could use as a trigger to three, therefore, one gage on each of the trusses was used as a trigger. In both of the main trusses and in the floor truss, the lower chord was chosen for triggering. This is due to the fact that these chords typically display the highest stress ranges.

The gages on the reversal and the high-tension members were monitored using constant data collection on two separate occasions for about two hours each time. Since these members were such a great distance from the electrical enclosure, taking sample data separately from the gages at panel point 10 proved to be more practical. Therefore a temporary data collection station was set up in a vehicle parked on the walkway below these members. Lead wires were simply dropped to this vehicle during data collection.

Data Collection System

For the truck tests conducted, data were collected using a Campbell Scientific CR9000 data logger. This system is a high-speed multi-channel digital data acquisition system with 16-bit resolution. During these tests, data were collected on between 4 and 18 strain gages at sampling rates of 50 Hz. Running the CR9000 off of its battery gave a cleaner signal than with electrical power. All data were temporarily stored on PCMCIA cards installed on the logger. The data were subsequently copied to a laptop at the end of each test for processing and back-up.

Data were also collected during the long-term monitoring of the bridge using the CR9000 logger. Since the logger was left running for more than a week before the PCMCIA cards were retrieved for data conversion, running off the logger's battery was impossible. Therefore, a temporary power supply running off the bridge's navigational lights was installed and supplied by Mn/DOT. Using external power produced noise in the signal, therefore, to reduce the noise levels in the data a surge protector with a line filter was used.

CHAPTER 5

SUMMARY OF RESULTS

TEST 1 RESULTS

The goal of the first test was to get the greatest response possible under static conditions in the floor truss. Figure 12 shows a time history of the lower chord in the floor truss during this test. There was a discontinuity in the recording before and after the trucks were in position, making it appear as though the load is applied instantly instead of slowly increasing as the trucks neared the gages. The measured strains show that the lower chord goes into tension as expected. The peak stress range is 28 MPa, which is actually the largest stress range recorded in any member in any test.

TEST 2 RESULTS

The goal of the second test was to get the greatest response possible in the main truss. The trucks were driven in the three by three pattern to get a very dense distributed load in all lanes. The measured strains show that the lower chord goes into compression as expected. The greatest stress ranges from this formation of trucks took place in the lower chord and measured 13 MPa. The time history of the response in the lower chord is shown in Figure 13a.

Figures 13b and 13c show the stress ranges in the diagonal and upper chord from the truss during the same event. The stress ranges in the diagonal and upper chord during this test were 10 and 8 MPa, respectively.

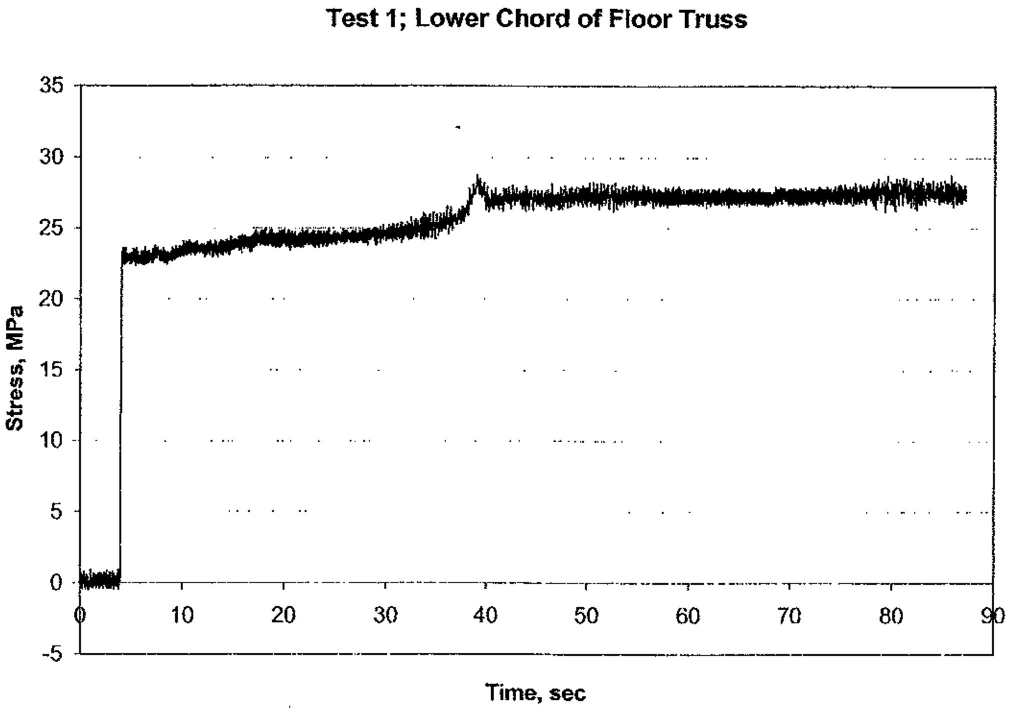
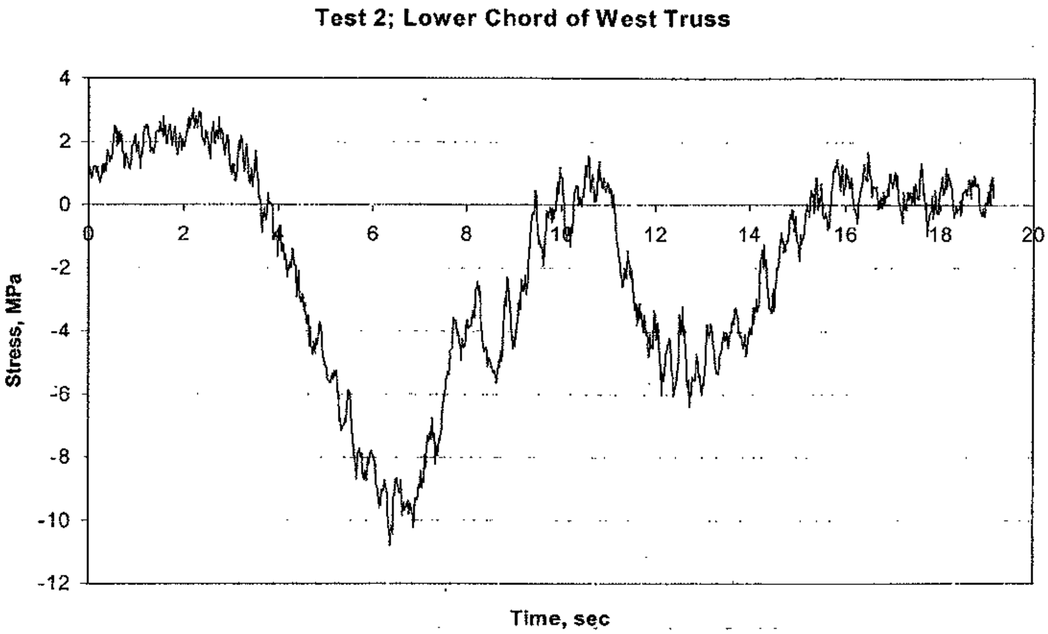
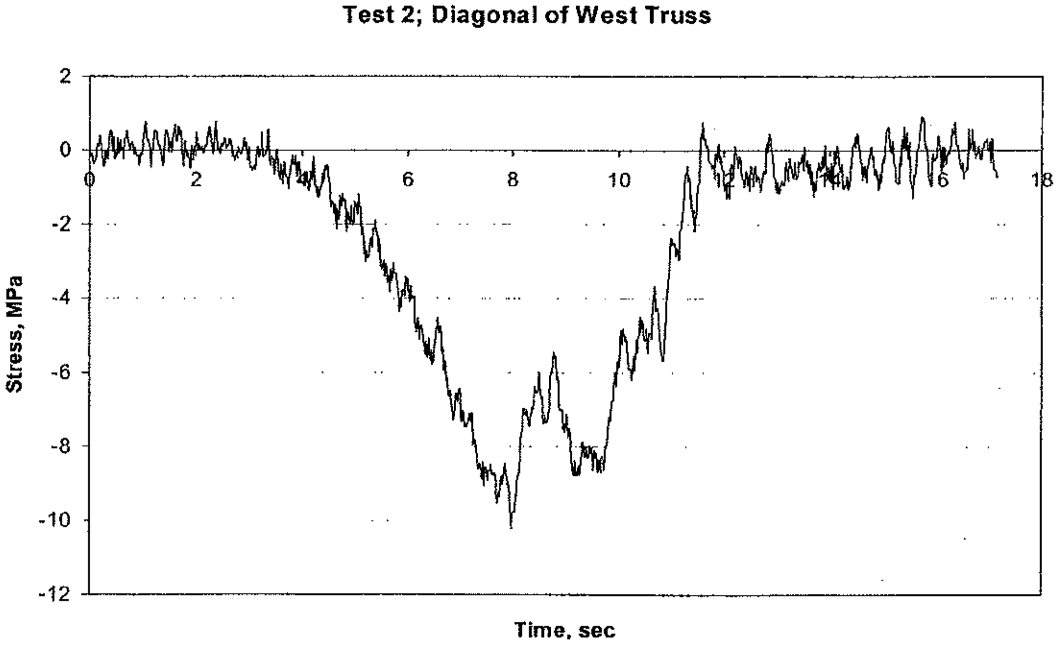


Figure 12: Time History of the Response During Test 1



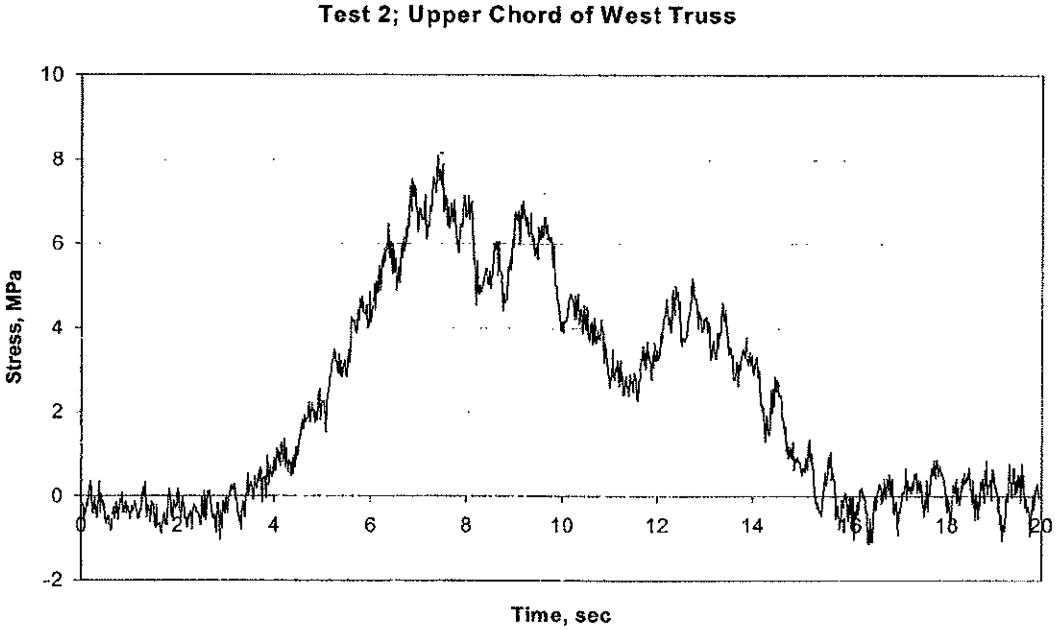
Test 2; Lower Chord of West Truss

A



Test 2; Diagonal of West Truss

B



C

Figure 13: Time Histories of the Response During Test 2

TEST 3 RESULTS

The goal of the third test was to load one of the main trusses directly with a line of trucks. However, the trucks were unable to follow any closer than 30.5 meters, resulting in the inability to achieve the desired effect. Instead, the truss responded to the loading of only one truck at a time. The effect of one truck on the truss is barely discernible, and the resulting stress ranges were less than 3.5 MPa. As a result of these low stress ranges, this test will not be discussed further.

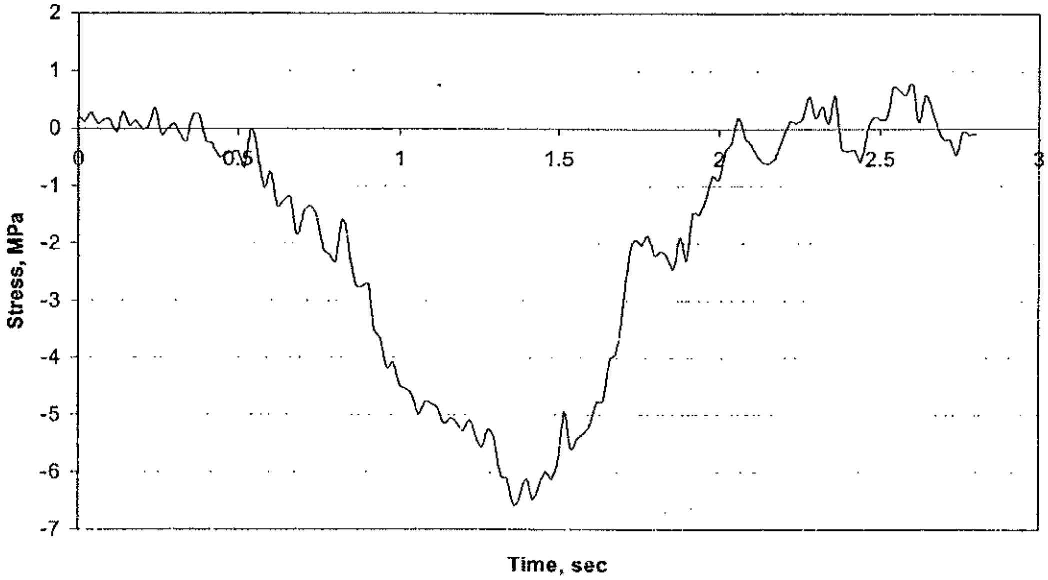
TEST 4 RESULTS

This test was another attempt at creating large stress ranges in the floor truss, as well as a means to determine how the load was distributed across the width of the bridge. The maximum stress range for this test occurred in the lower chord of the floor truss and measured 14 MPa. The diagonal and upper chord of the floor truss experienced a maximum stress range of 9 and 7 MPa, respectively. The maximum stress range in the main truss was in the lower chord of the west truss and measured 8 MPa. The maximum stress ranges in the upper chord and diagonal measured 5 and 6 MPa, respectively. The time histories for all gaged members of the floor truss and west truss are shown in Figures 14a-f.

OPEN TRAFFIC RESULTS

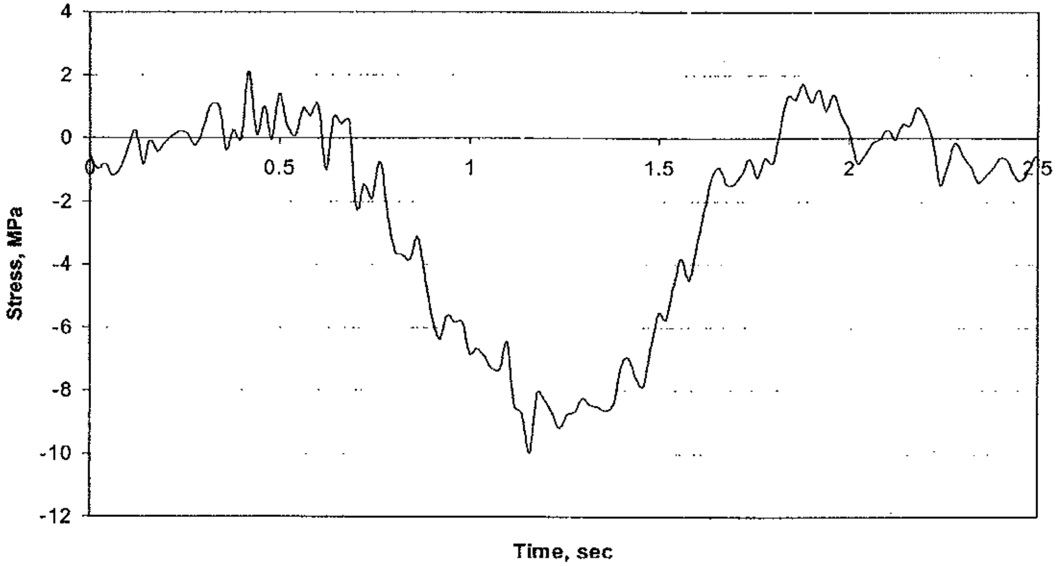
Open traffic was monitored during a four-month duration. Continuous data were collected for a limited time and during most of the time data were only recorded when triggered. During this time, the maximum stress ranges in each truss were 13 MPa in the lower chord of the east truss, 12 MPa in the lower chord of the west truss and 26 MPa in the diagonal of the floor truss.

Test 4; Upper Chord of Floor Truss



A

Test 4; Diagonal of Floor Truss



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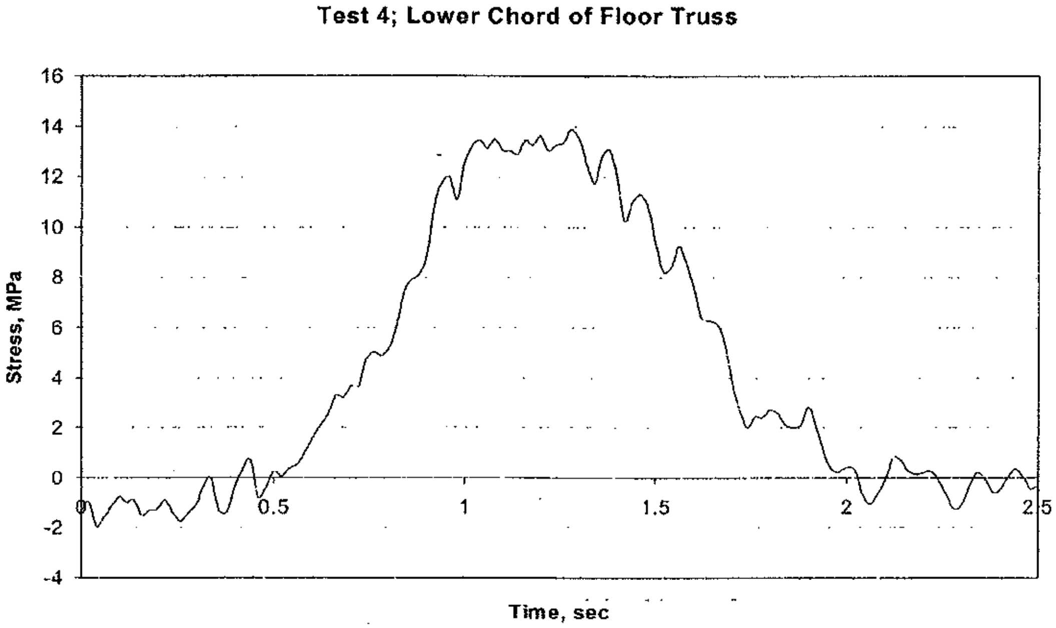
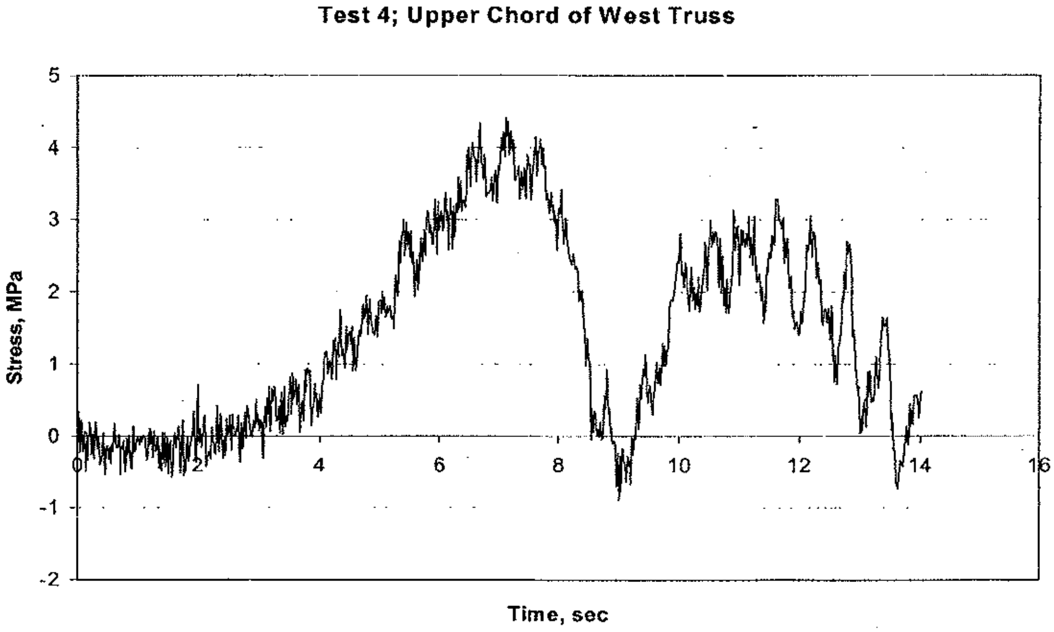
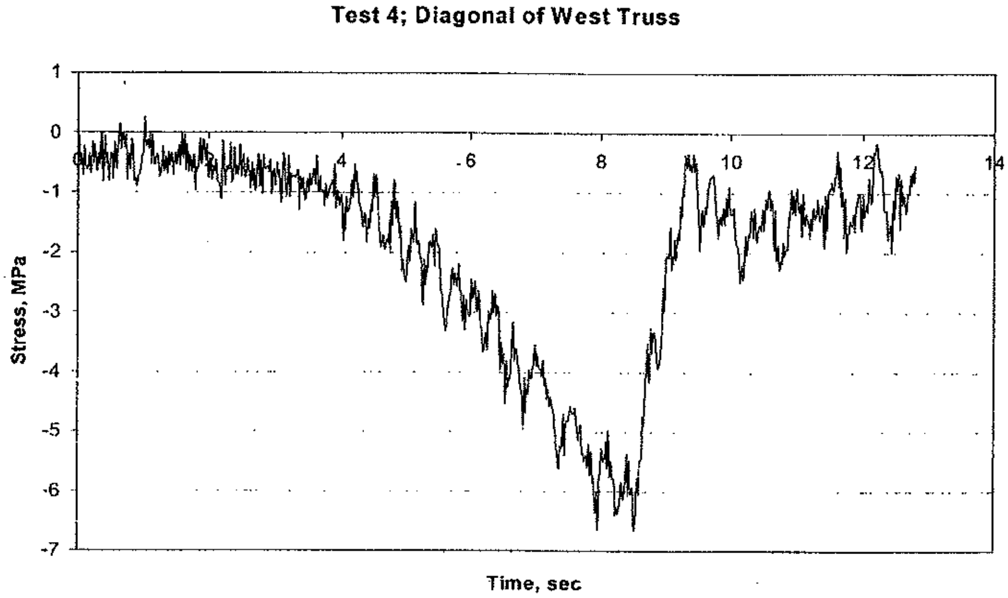

Test 4; Lower Chord of Floor Truss
Stress, MPa
16
14
12
10
8
6
4
2
0
-2
-4
0
0.5
1
1.5
2
2.5
Time, sec

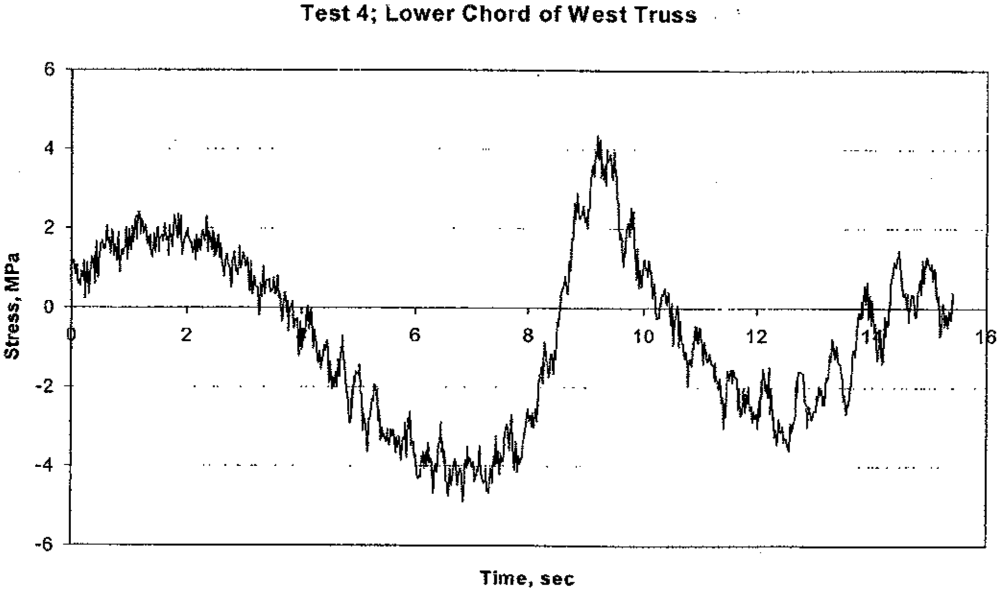
C


Test 4; Upper Chord of West Truss
Stress, MPa
5
4
3
2
1
0
-1
-2
0
2
4
6
8
10
12
14
16
Time, sec

D



E



F

Figure 14: Time Histories of the Response During Test 4

Note that these peak stress ranges are comparable to the stress ranges measured during the controlled load tests.

The largest floor truss stress history is presented in Figure 15. The diagonal member is in compression when a load is traveling in the northbound direction, directly over the gaged members, and is in tension when a load is traveling in the southbound direction. Therefore it can be assumed that this large event occurred when two large trucks, each traveling in opposite directions, passed the gaged location within seconds of each other.

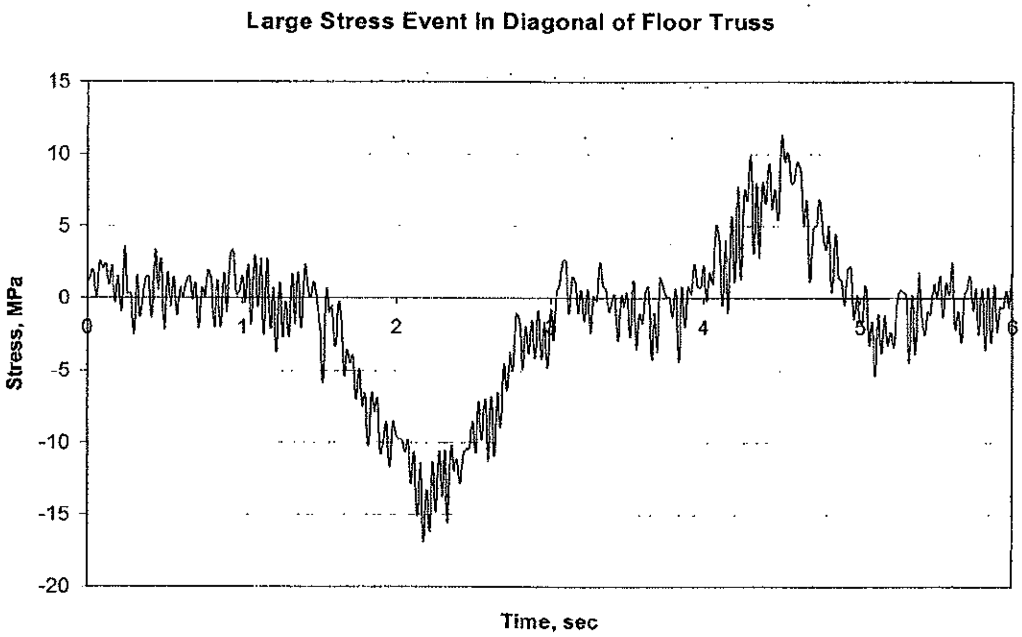


Figure 15: Largest Stress Event Recorded in Open Traffic Conditions

All data collected were imported into an Excel spreadsheet and cycles were counted using an algorithm programmed in Visual Basic in Excel. The algorithm is based on the "level-crossing" cycle counting method. This method counts a new cycle every time the stress crosses from below the mean to above a designated threshold.

To avoid counting thousands of small insignificant fluctuations as stress cycles, cycles were not counted until the stress increased above a threshold stress, which was set at 4.5 MPa, which is less than 15 percent of the smallest fatigue limit (31 MPa for Category E). The stress range associated with a cycle is the algebraic difference between the maximum peak of the stress value between incidents of crossing the cut-off stress and the minimum stress.

This method ignores the fluctuations that occur in a cycle. For example, if one were to apply this method to the main truss, the cycle in Figure 13b would be counted as one cycle with a range of 10 MPa. Note that after the peak, the stress declined to about 5.5 MPa and then increased again to about 8.75 MPa. This intermediate stress range of 3.25 MPa (from 5.5 to 8.75 MPa) is ignored. The level crossing method is the most appropriate for this type of loading as it gives a better correspondence between cycles and trucks. Since, as it turns out, none of the stress ranges exceed the thresholds for the details, the effect of ignoring the smaller intermediate stress ranges is inconsequential.

Each stress range over the cut-off stress of 4.5 MPa was tabulated. These stress ranges were sorted into discrete bins of 3.5 MPa intervals for each member in the floor truss. The distributions of the stress range data for continuous periods of monitoring are presented in Tables 3-5.

Table 3: Stress Range Percentages During Constant Data Collection For the East Truss

Stress Range (MPa)	Upper Chord	Diagonal	Lower Chord
0-3.5	56.4	16.6	4.1
3.5-7	43.6	80.7	42.7
7-10.5	0.0	2.7	48.5
10.5-14	0.0	0.0	4.7

Table 4: Stress Range Percentages During Constant Data Collection For the West Truss

Stress Range (MPa)	Upper Chord	Diagonal	Lower Chord
0-3.5	65.0	49.4	9.1
3.5-7	35.0	49.8	78.4
7-10.5	0.0	0.8	11.9
10.5-14	0.0	0.0	0.6

Table 5: Stress Range Percentages During Constant Data Collection For the Floor Truss

Stress Range (MPa)	Upper Chord	Diagonal	Lower Chord
0-3.5	3.8	2.3	1.9
3.5-7	76.4	48.7	40.5
7-10.5	19.2	36.0	34.1
10.5-14	0.6	10.6	18.3
14-17.5	0.0	2.0	4.3
17.5-21	0.0	0.3	0.9
21-24.5	0.0	0.06	0.1
24.5-28	0.0	0.03	0.0

From the above tables it can be seen that the percentage of stress ranges in each bin for the east truss is very similar to that of the west truss, with slightly greater stress ranges in the east truss (under the northbound traffic). It is also notable that less than one in 1000 stress events in the diagonal of the floor truss exceeds 21 MPa and less than one in 3300 stress events in this member exceed 24.5 MPa. Not a single stress event recorded in any truss during constant data collection exceeded its fatigue threshold or CAFL for the details.

These histograms were then used to determine an effective stress range for each member using Equation 1. The fatigue damage caused by a given number of cycles of the effective stress range is the same as the damage caused by an equal number of the different stress ranges defined by the histograms. The effective stress ranges for the east, west and floor trusses are shown in Table 6. Again, the east truss seems to have slightly greater effective stress ranges.

Table 6: Effective Stress Ranges From Constant Data Collection

Member	East Truss	West Truss	Floor Truss
Upper Chord	4.04 MPa	3.78 MPa	6.89 MPa
Diagonal	5.14	4.31	13.91
Lower Chord	10.27	6.51	17.03

The gages in the east truss displayed excessive noise during triggered data collection and therefore are not included in the following discussion. The stress distributions displayed as percentages of all stress ranges recorded during triggered data collection are presented in Tables 7 and 8 and the effective stress ranges for each member of each truss are presented in Table 9.

Table 7: Stress Range Percentages During Triggered Data Collection For the West Truss

Stress Range (MPa)	Upper Chord	Diagonal	Lower Chord
0-3.5	58.5	38.6	30.0
3.5-7	41.4	61.0	43.2
7-10.5	0.0	0.4	26.4
10.5-14	0.0	0.0	0.4

Table 8: Stress Range Percentages During Triggered Data Collection For the Floor Truss

Stress Range (MPa)	Upper Chord	Diagonal	Lower Chord
0-3.5	13.3	36.8	3.0
3.5-7	51.1	30.9	24.5
7-10.5	34.2	25.5	55.0
10.5-14	1.4	5.5	14.6
14-17.5	0.0	1.0	2.7
17.5-21	0.0	0.2	0.3
21-24.5	0.0	0.04	0.01

Table 9: Effective Stress Ranges From Triggered Data Collection

Member	West Truss	Floor Truss
Upper Chord	3.83 MPa	6.6 MPa
Diagonal	4.53	7.06
Lower Chord	7.37	7.26

These distributions of triggered data are not directly comparable to the distributions shown in Tables 3-5, because a substantial number of the stress ranges are not recorded during the triggered-data periods. The triggering was based on large stress ranges in the lower chords of the trusses, therefore the distributions and effective stress ranges for the triggered data in the diagonal and upper chord of the main truss and floor truss show a larger percentage of smaller stress ranges. However, the peaks of the distributions look similar.

REVERSAL AND HIGH-TENSION-STRESS MEMBER TEST RESULTS

A limited amount of continuous open-traffic data was also taken for the reversal and high-tension-stress members of the main truss. The data were reduced in the same manner as in the open traffic tests using the algorithm programmed in Visual Basic in Excel. The individual stress events were separated into bins, and the resulting percentages of all stress events in each bin are presented in Table 10.

The effective stress range members L3U4 and U4U6 are 7.9 and 5.7 MPa, respectively. The largest stress range recorded was 22 MPa in the high-tension-stress member, L3U4. The time history of this event is presented in Figure 16. The stress ranges recorded for the reversal member, U4U6, never exceeded 13 MPa.

Table 10: Stress Range Percentages During Continuous Data Collection for the Reversal Member (U4U6) and High-Tension-Stress Members (L3U4)

Stress Range (MPa)	L3U4	U4U6
0-3.5	5.2	1.0
3.5-7	63.3	92.4
7-10.5	21.9	6.3
10.5-14	6.9	0.3
14-17.5	2.3	0.0
17.5-21	0.1	0.0
21-24.5	0.3	0.0

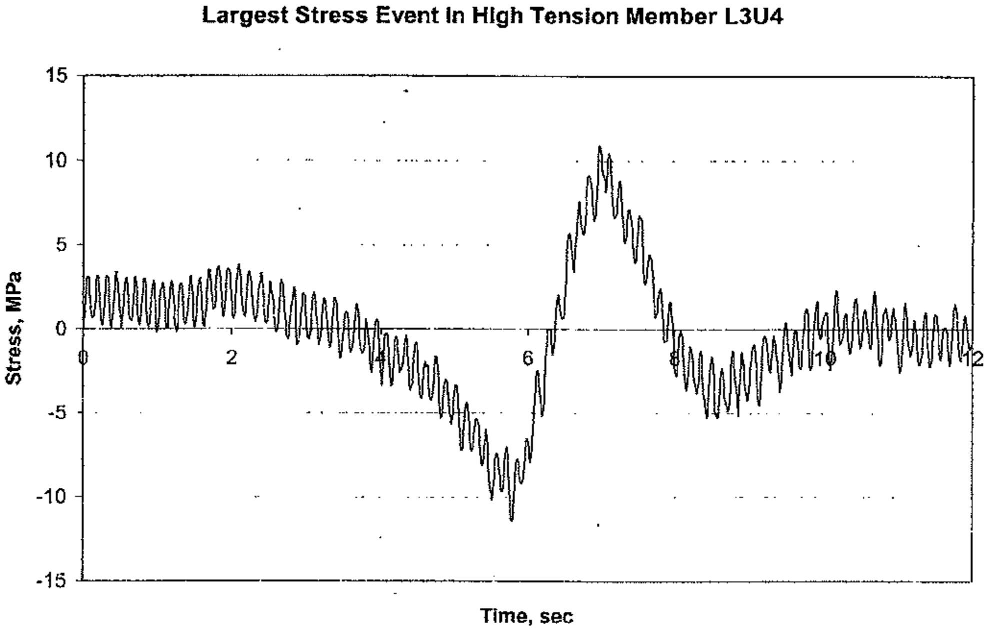


Figure 16: Largest Stress Event in High-Tension-Stress Member L3U4

CHAPTER 6

RESULTS OF ANALYSES

2-D ANALYSIS OF MAIN TRUSS

The computer program Visual Analysis was used to model the main truss and analyze the loads applied during Tests 2 and 4. First, a two-dimensional model of the main truss was created based on the plan dimensions (Figure 17). Influence lines were then calculated for the trusses across the width of the bridge and between panel points along the length of the bridge to determine how the loads would be distributed.

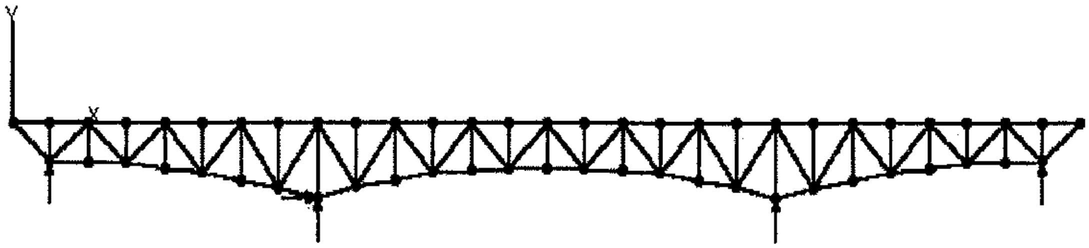


Figure 17: 2-D Visual Analysis Model of Main Truss

To apply the loads, 227 kN Mn/DOT tandem axle trucks were modeled as having only a front and rear axle spaced at 4.88 meters. We did not have measurements of each axle weight, so we assumed one third of the truck weight was placed on the front axle, and two-thirds was placed on the rear axle. This weight distribution was estimated from independent axle weigh tickets of trucks used in the study of Bridge 4654 [12].

Test 2

The load distribution across the bridge deck was first checked by plotting the time histories for an east truss and west truss member during Test 2. The percentage of the west truss member stress felt by the east truss was then compared to the percentage predicted by an influence line. The data presented in Figure 18 shows that the east truss recorded 30 percent of the stress recorded in the west truss during Test 2. Calculations from a simple influence line yield a percentage of 28, suggesting good agreement between theoretical and actual distribution.

To analyze the results of Test 2, trucks were centered in their lanes as shown in Figure 11b. By measuring the time between peaks in the stress history and estimating the trucks travel speed at 88 kph, it was determined that the following distances for the three rows of trucks was 30.5 and 39.6 meters. Loads were applied to the model with appropriate distances between them and were moved across the length of the bridge.

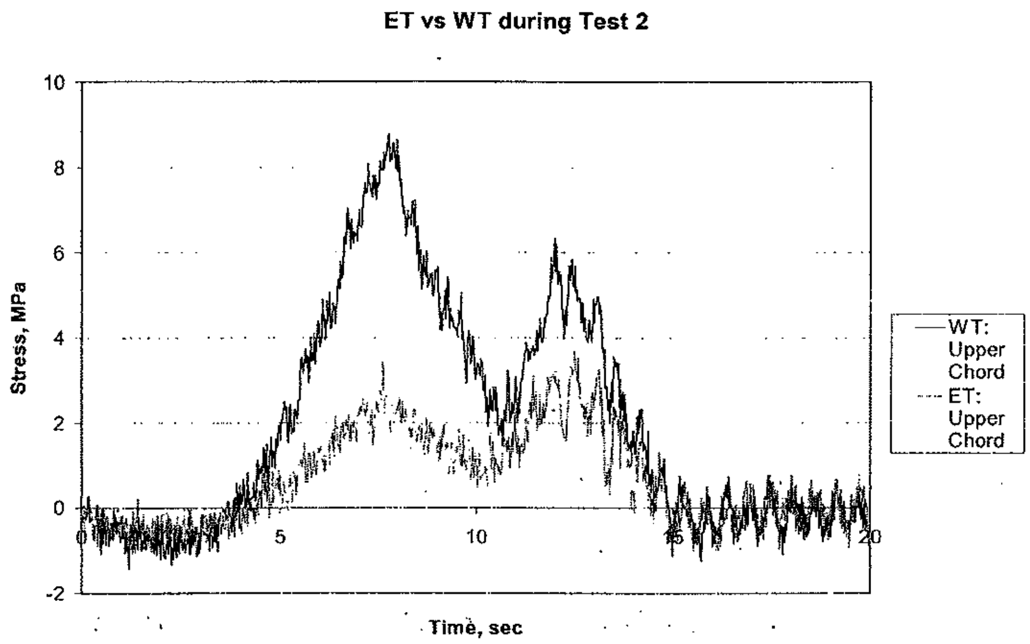
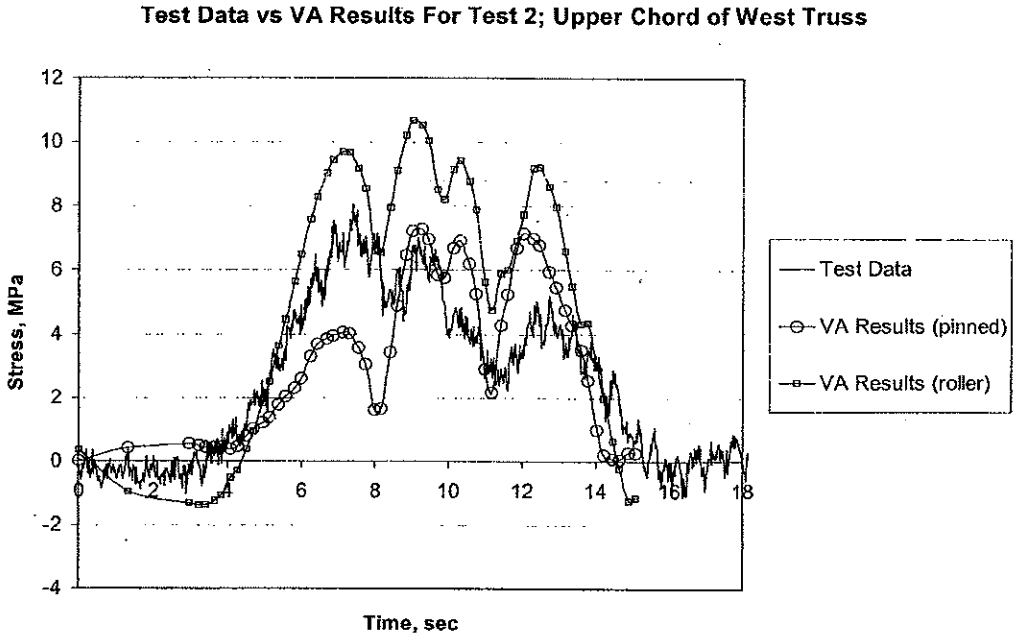


Figure 18: Distribution of Load Across the Bridge Deck

As discussed in Chapter 2, the disparity between actual and predicted stress ranges can often be attributed to unexpected partial end fixity at abutments. Therefore, the bridge was first modeled as designed with three of the four bearings defined as roller connections, allowing displacement along the length of the bridge. A second model was then made where all bearings were pin connections, restricting any longitudinal displacement. The effect of restraining the movement from the live load is to make the truss behave more like an arch, which increases the compressive force in the lower diagonal but reduces the forces in the diagonal and upper chord.

From the plots of the analytical results versus the actual time histories for Test 2 in Figure 19a-c, one can see that for the upper and lower chord, the actual stress lies somewhere in between the roller support and pinned support analyses. This is to be expected, as it is unlikely that the support neither totally restrains movement nor is completely free.



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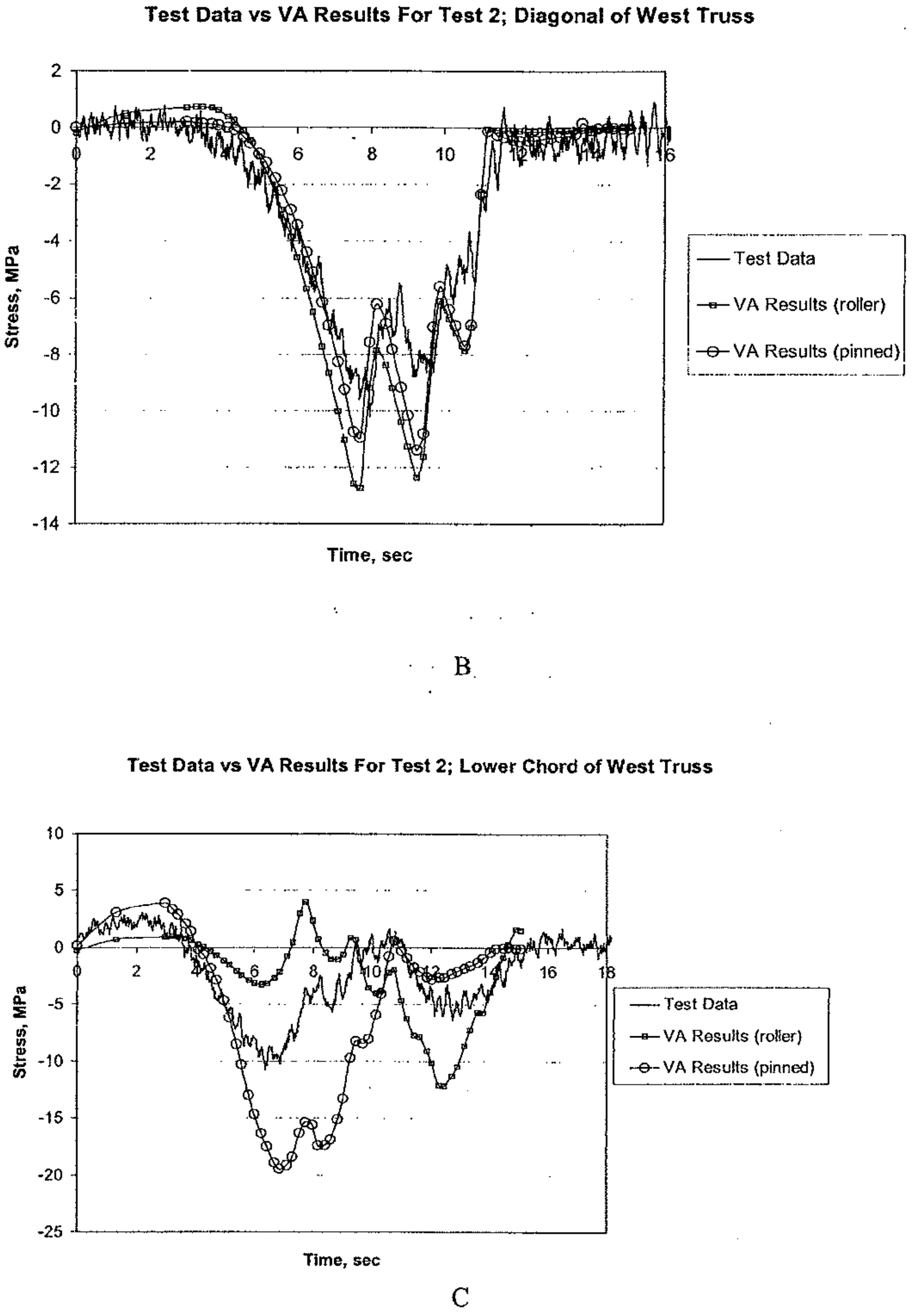


Figure 19: Comparison of 2-D Analysis and Test Data for Main Truss in Test 2

The resulting ratios of actual to predicted stress ranges for each member are presented in Table 11. The agreement of the upper chord and diagonal members is better with the pinned model. For the lower chord, the roller model gives a stress range that is in better agreement with the actual measured stress range. However, Figure 19c shows that the shape of the stress history is much closer to the pinned model.

Table 11: Ratio of Actual to Predicted Stresses in Main Truss for 2-D Analysis of Test 2

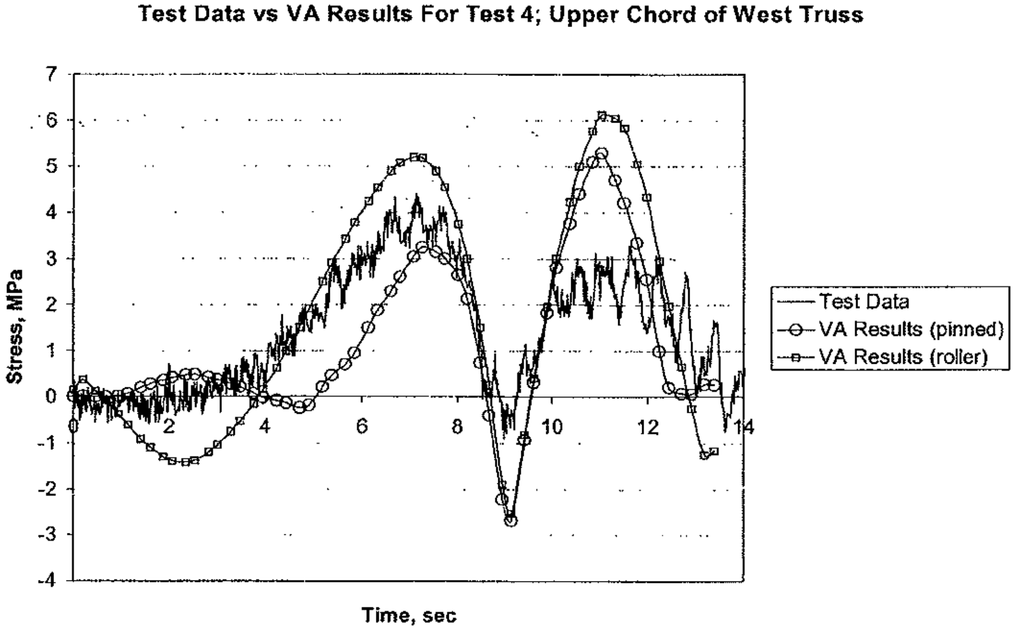
Member	Roller Bearings	Pinned Bearings
Upper Chord	68%	113%
Diagonal	58%	82%
Lower Chord	78%	53%

The upper chord recorded a stress range of 8 MPa during Test 2. Comparatively, analysis predicted stress ranges of 11.7 and 7.1 MPa for roller and pinned bearings, respectively. Likewise for the diagonal, the recorded stress range was 9.5 MPa and predicted stress ranges were 16.4 and 11.6 MPa for roller and pinned bearings. Lastly, for the lower chord, the recorded stress range was 12.5 MPa while the predicted stress ranges were 16.1 and 23.4 for roller and pinned bearings.

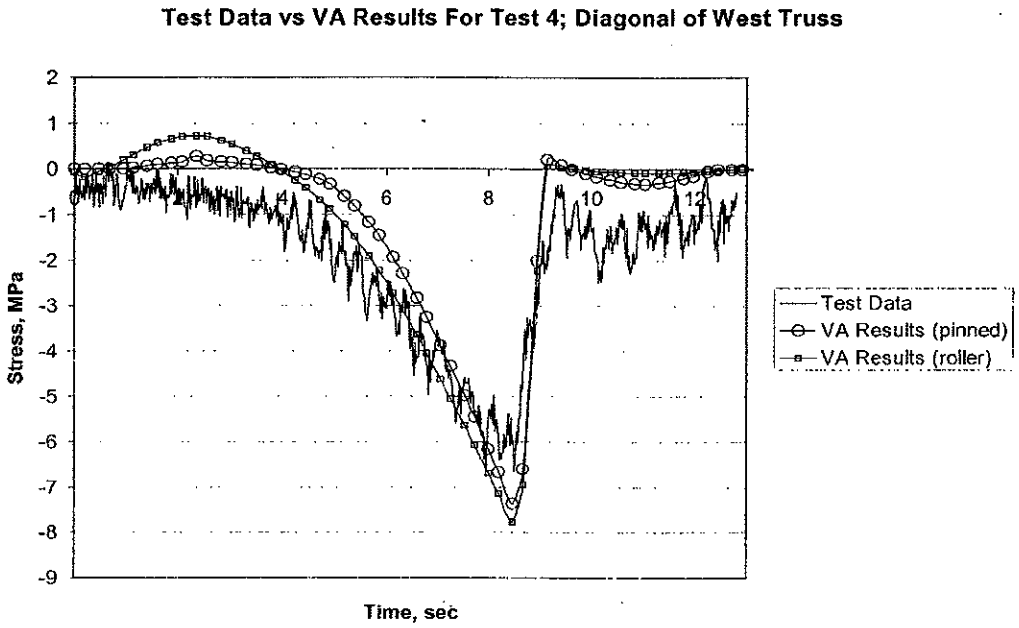
In conjunction with the unknown amount of fixity at the bearings, many other assumptions made in analysis could have led to the variance between actual and predicted stress ranges.

Test 4

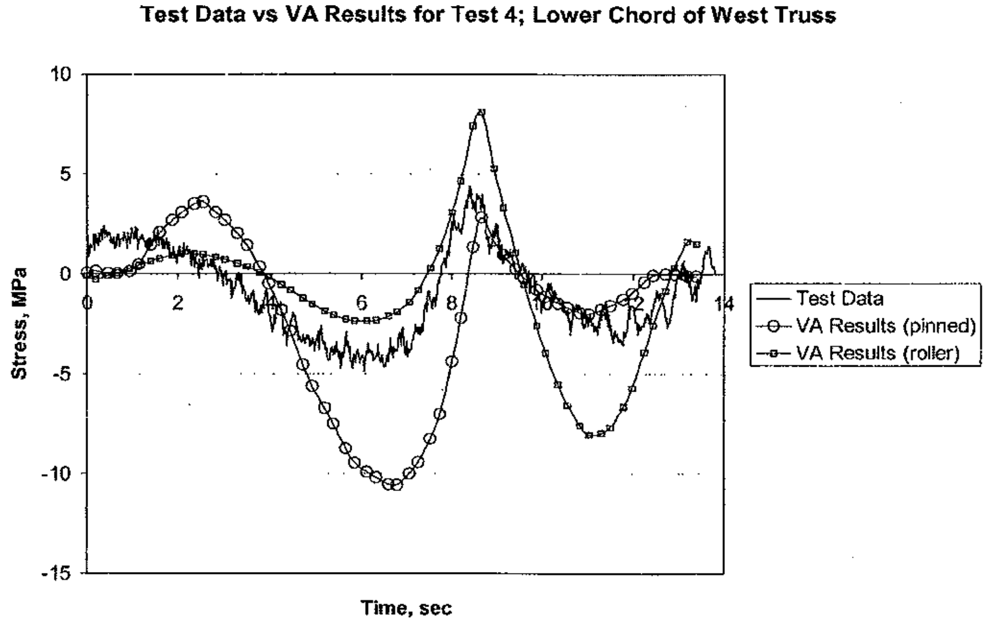
Test 4 was analyzed with the same model used to analyze Test 2. The bridge pier supports were also again modeled using roller bearings and pinned bearings. Influence lines were used to determine how loads were to be applied to the model. It was assumed that the trucks were centered in each lane and aligned as shown in Figure 11d. The results of the analyses are shown in Figures 20a-c.



A



B



C

Figure 20: Comparison of 2-D Analysis and Test Data for Main Truss in Test 4

The results of the analyses again show that for the upper and lower chords, the actual response fall between the predictions for roller and pinned bearings. The predicted response of the diagonal also shows that the bearing type has little effect on the internal stress. This is in good agreement with the analyses for Test 2.

During Test 4 the upper chord of the main truss recorded a stress range of 5 MPa. Comparatively, analysis predicted stress ranges of 9 and 8 MPa for roller and pinned bearings, respectively. The diagonal recorded a stress range of 6 MPa and predicted stress ranges were 9 and 8 MPa for roller and pinned bearings. Finally, the lower chord recorded a stress range of 8 MPa while the predicted stress ranges were 16 and 14 for roller and pinned bearings. The resulting ratios of actual to predicted stress ranges for each member are presented in Table 12.

Table 12: Ratio of Actual to Predicted Stresses in Main Truss for 2-D Analysis of Test 4

Member	Roller Bearings	Pinned Bearings
Upper Chord	58%	63%
Diagonal	71%	78%
Lower Chord	50%	56%

The ratios of actual to predicted stresses are much more consistent for Test 4 than for Test 2. This is most likely due to the fact that the formation for Test 4 was easier to maintain than the Test 2 formation. Here the analyses with pinned bearings were consistently more accurate than that with roller bearings.

3-D ANALYSIS OF TRUSS SYSTEM

As discussed in Chapter 2, unexpected composite action between the deck and stringers in bridges often occurs, resulting in different values for actual and predicted stresses. To try and refine the analyses conducted on the main truss, a three-dimensional model incorporating the concrete deck was constructed using SAP2000. For simplicity, the deck was modeled as a beam running transverse to the roadway with a thickness of 16.5 cm (the actual thickness of the deck) and a width of 8.0 m, the effective width given the span length as defined by ACI [23]. Instead of sitting atop stringers, short, stiff stub columns were used. W27x539 shapes were selected for the columns for maximum stiffness and placed at the nodes of the upper chords of the floor truss .(Figure 21).

Since the 3-D analysis is meant to refine the current analyses, it was only applied to Test 4 as it was the most accurate and consistent under 2-D analysis. The bearings were again modeled as both roller and pinned supports. The results of the analyses are presented in Figure 22a-c.

The stress ranges were more accurate for the upper chord and diagonal, but the stress ranges in the lower chord ranged from worse when the bearings were modeled as rollers to only slightly better with pinned bearings. In the upper chord, the predicted stresses for roller and pinned bearings were 5.2 and 5.4 MPa, respectively, compared to an actual stress range of 5 MPa. The diagonal recorded a stress range of 6 MPa while the analyses predicted 11.4 and 11.7 MPa for the roller and pinned bearings. Lastly, the lower chord recorded a stress range of 8 MPa and analyses predicted 16 and 11.7 MPa for the roller and pinned bearings. The ratio of actual to predicted stress ranges is presented in Table 13.

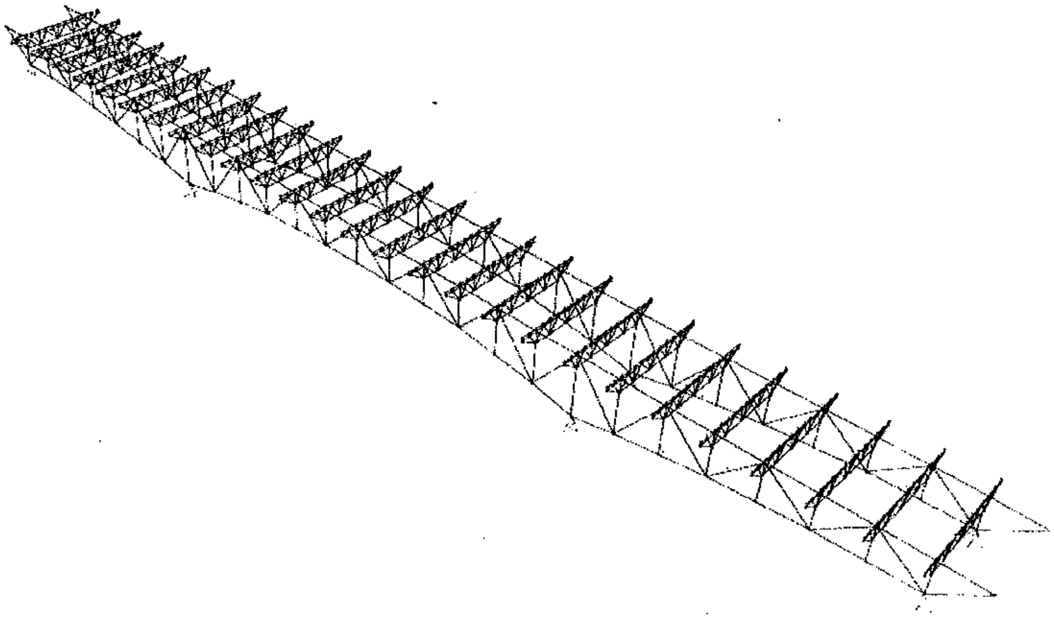
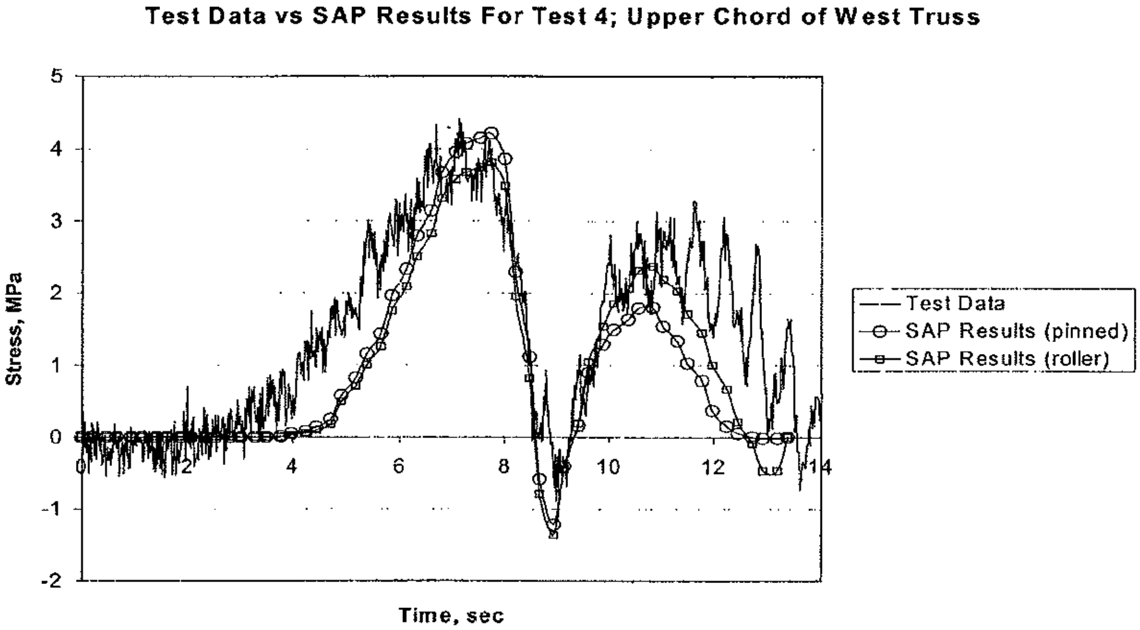
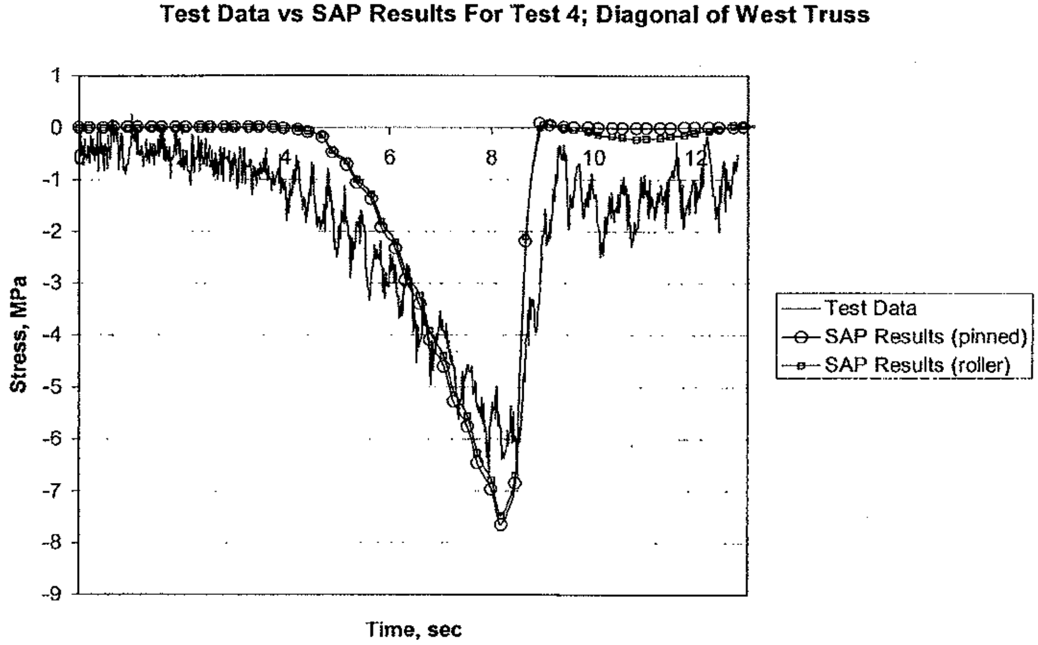


Figure 21: 3-D SAP2000 Model



Test Data vs SAP Results For Test 4; Upper Chord of West Truss

A



Test Data vs SAP Results For Test 4; Diagonal of West Truss

B

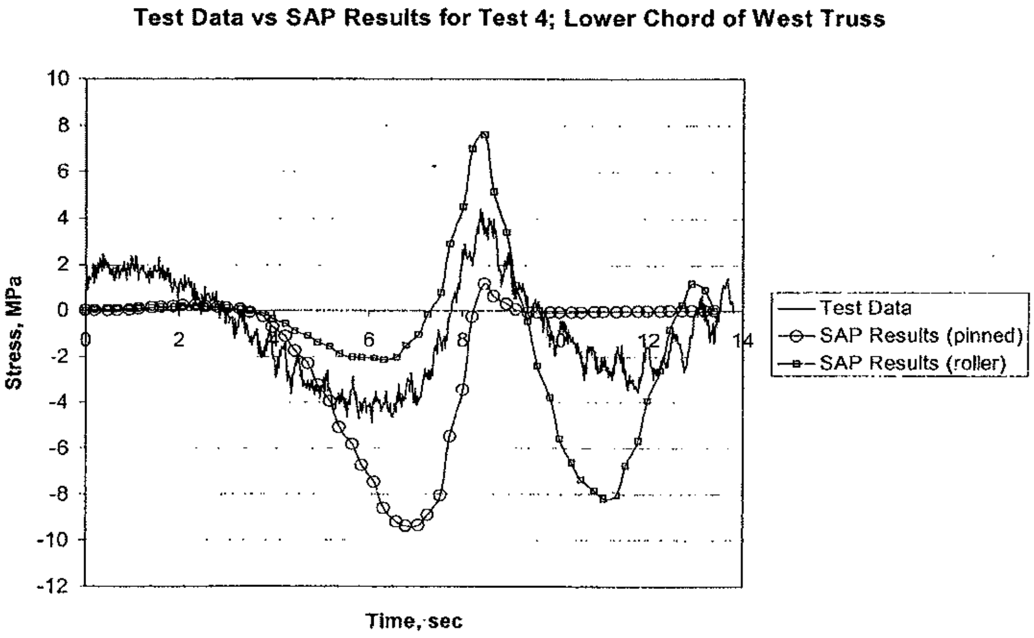


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Figure 22: Comparison of 3-D Analysis and Test Data for Main Truss in Test 4

Table 13: Ratio of Actual to Predicted Stresses in Main Truss for 3-D Analysis of Test 4

Member	Roller Bearings	Pinned Bearings
Upper Chord	96%	93%
Diagonal	80%	78%
Lower Chord	50%	75%

The type of bearing used in analysis had minor effects on the results for the upper chord and diagonal, however, the predicted response of the lower chord changed drastically. The total stress range of the lower chord was 75 percent of the actual stress range using pinned bearings in the model, however, once the row of trucks passed over the pier to the south of the lower chord, the predicted stresses went to zero. When the bearing to the south of the lower chord is pinned, it prevents any horizontal load from being transferred to the lower chord. The fact that the lower chord did feel load after the trucks passed the bearing to the south of it again confirms the assumption that the bearings are neither fully restrained nor free to displace.

The ratio of actual to predicted stresses in the diagonal were the same as in the 2-D analysis when pinned bearings were used, however, the ratio increased by nine percent from the 2-D analysis when roller bearings were used. Still, the predicted response for the diagonal changed the least under 3-D analysis. This follows that there are not any alternative load paths for the flow of shear force in the truss regardless of changes made at the upper or lower chords.

The upper chord predictions changed the most from the 2-D to 3-D analysis. By adding the concrete deck, the effective depth of the truss was slightly increased thus lowering the predicted stresses in the upper chord. This confirms that the concrete deck contributes a significant amount of stiffness to the truss system and should be included in any model of the bridge.

POSSIBLE PROBLEM MEMBERS AND REMAINING LIFE IN MAIN TRUSS

Based on the completed analysis and recorded stress ranges in open traffic conditions, members that may exceed the fatigue limit can be identified. The largest stresses recorded in testing occurred during Test 2. The results from a Visual Analysis model using this loading and both pinned and roller bearings are shown in Table 14.

Table 14: Predicted Stresses Exceeding Fatigue Limit During Test 2

Member	Roller Bearings	Pinned Bearings
U2L3	54 MPa	42 MPa
L3U4	49	47
U4U6	56	40

When the roller bearings are assumed, the analysis predicts that members U2L3, L3U4, and U4U6 could experience stress ranges slightly larger than the 48 MPa CAFL for the Category D details (the short clips on the diaphragms). However, when the bearings are assumed pinned, which was shown to be the more accurate assumption, the predicted stress ranges do not exceed the CAFL. Even with the pinned assumption, however, the analysis still over-predicts the stress ranges significantly. Therefore the actual stress ranges due to this loading would be even less than the stress ranges in Table 14.

The first two of these members are diagonals while the last is an upper chord. The ratio of actual to predicted stresses for diagonals and upper chords was consistently between 58 and 78 percent for the 2-D analysis of Test 4. If the largest ratio were applied to the predicted stress ranges in Table 14, the resulting stress ranges would all fall well below the CAFL (Table 15). Therefore, all stress ranges for all members in the main truss fall below the fatigue limit for a Category D detail and remaining life for this structure is infinite.

Table 15: Corrected Predicted Stresses For Problem Members During Test 2

Member	Roller Bearings	Pinned Bearings
U2L3	42.1 MPa	32.8 MPa
L3U4	38.2	36.7
U4U6	43.7	31.2

2-D ANALYSIS OF FLOOR TRUSS

Visual Analysis was also used to create a two-dimensional model of the floor truss to analyze Tests 1 and 4 (Figure 23). A concrete deck was incorporated into the model to account for added strength from unexpected composite action. As in the 3-D analysis, the deck was modeled as a 16.5 cm by .8 m beam resting atop stiff stub W27x539 columns.

Test 1

To get analytical results for the first test, the front axle of a truck was assumed to be 4.57 meters away from the rear axle of the truck directly in front of it. An influence line for the floor truss showed that the load on the truss would be largest when the rear axle of the center truck was directly on the truss. For simplicity, a single load for each axle was applied at the center of each interior lane. The maximum stress range during this test occurred in the lower chord and measured 28 MPa. The analysis yielded a maximum stress for the same member of 36.7 MPa, yielding an actual to predicted stress range ratio of 76 percent. If the distance between the front and rear axles was reduced to 3.05 meters, the analysis yielded a maximum stress in the lower chord of 42.8 MPa, a ratio of 65 percent.

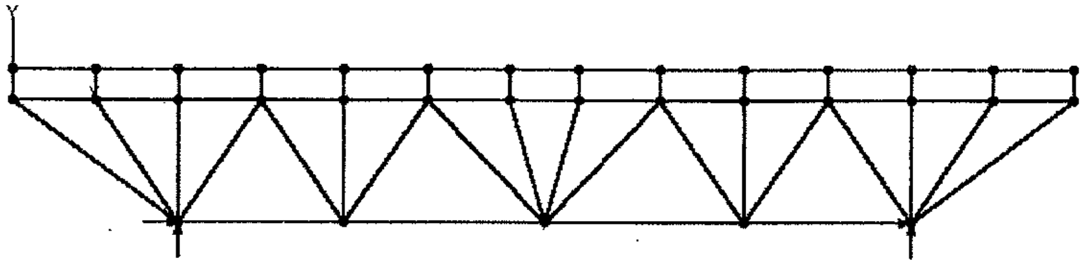
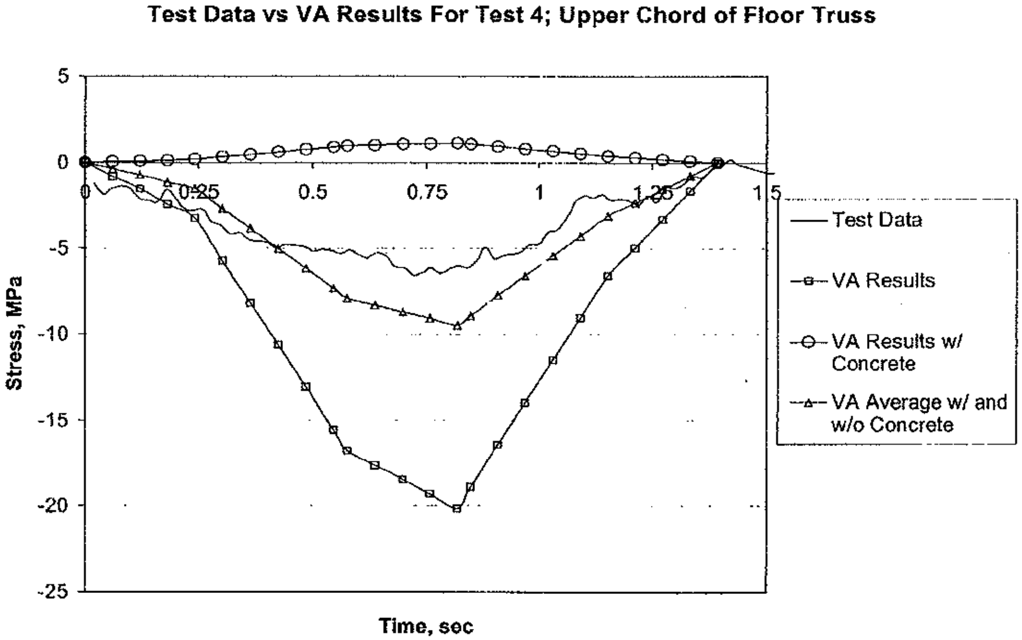


Figure 23: 2-D Visual Analysis Model of Floor Truss with Concrete Deck

Test 4

Analyses of the floor truss results for the fourth test were done in much the same way. Truck loads were applied to an influence line, which was used to determine the load distribution between neighboring floor trusses as the line of trucks moved across the bridge. Analysis was done with and without the concrete deck in place. Later, these results were averages. The time histories for each member of the floor truss versus the analysis results are shown in Figures 24a-c.



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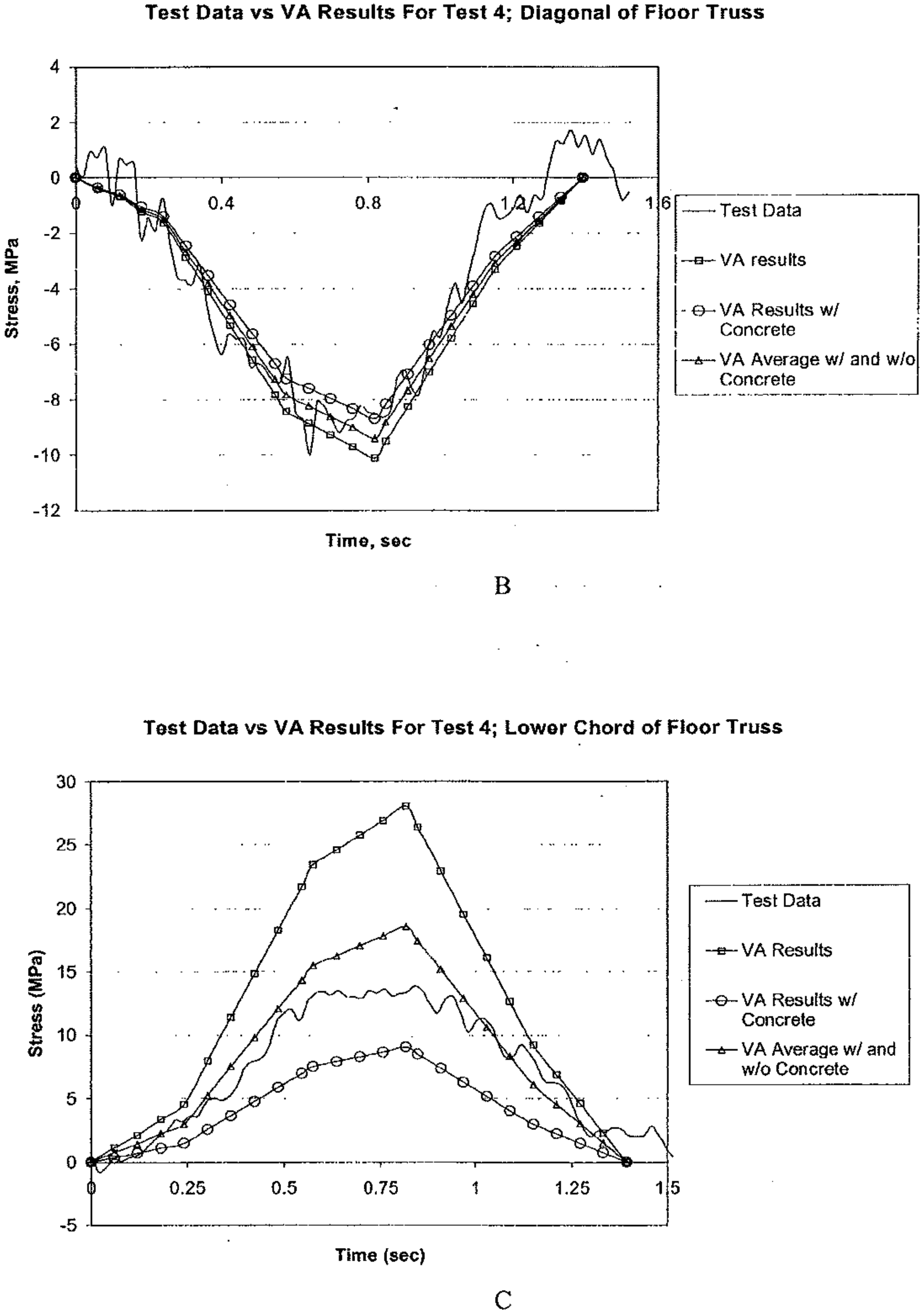

Figure 24: Comparison of 2-D Analysis and Test Data for Floor Truss in Test 4

From these figures, it can be seen that the analysis results from the upper chord and lower chord without the concrete deck in place are much higher than the recorded stresses. Including the deck lowers the stresses too much so the two separate predicted responses were averaged to estimate the contribution of the concrete deck. This averaged predicted response shows the best correlation to the actual response. The ratio of actual to predicted stress ranges is shown in Table 16.

Table 16: Ratio of Actual to Predicted Stresses in Floor Truss for 2-D Analysis of Test 4

Member	VA Results	VA w/ Concrete	Average
Upper Chord	33%	n/a	69.5%
Diagonal	91%	106%	98%
Lower Chord	49.5%	154.4	74.7%

The stress ranges felt in the diagonal are only slightly affected by the concrete deck. This follows the results of diagonals in the other analyses. There are no alternative load paths at the diagonals, therefore a change in supports or the addition of a concrete deck have little effect.

REMAINING LIFE OF THE FLOOR TRUSS

The predicted stress ranges in the floor truss never exceed the CAFL of 31 MPa for the Category E (stiffener) detail, therefore the remaining life of the floor truss is considered to be infinite. The largest predicted stress range for Test 4 occurs in member L1U4 and is 22.2 MPa when the results of the models with and without the concrete deck are averaged. Since this member is a diagonal, one can assume that the actual stress range in the member correlated well with the predicted stress range.

CHAPTER 7

SUMMARY AND CONCLUSIONS

Field tests and analyses were conducted on Bridge 9340 crossing the Mississippi River just east of downtown Minneapolis. Field tests were conducted in two parts. The first part involved measuring strains while trucks of known weights crossed the bridge. The second part involved monitoring the strains and counting strain cycles under open traffic conditions over a period of several months. Results of the first part were used to calibrate two and three-dimensional numerical models. Results of the second part were used to characterize the statistical distribution of the stress ranges and estimate the remaining fatigue life. The main conclusions were:

1. Inspection of the bridge revealed Category D details on the main truss members and Category E members on the floor truss. No fatigue cracks were found by visual inspection of those members.

2. The largest stress range measured in the main truss during the controlled tests was 12.5 MPa in the lower chord, from three rows of three trucks. The analyses show that member U4U6 would have the largest stress range from this loading, 46 MPa. This is less than the fatigue threshold for the most critical details on these members, which is 48 MPa for Category D.

3. The largest stress range in the main truss during the open-traffic monitoring was 22 MPa and this was in another member, L3U4.

4. The agreement of the analyses with the measured stress ranges was best when a three-dimensional model of the whole bridge was analyzed. In both the two-dimensional and three-dimensional analyses, the agreement was best if the roller bearings at the piers were assumed to be pinned so that a horizontal reaction developed and arching action occurred.

5. The largest stress range measured in the floor truss during the controlled tests was 28 MPa in the lower chord, from three rows of trucks in the leftmost lane (closest to the center) in each direction. This is less than the fatigue threshold of 31 MPa for a Category E detail.

6. The largest stress range in the floor truss during the open-traffic monitoring was 25 MPa and this was in a diagonal.

7. Two-dimensional analyses were adequate for the floor truss. Very poor agreement with the measured results was obtained unless some composite action with the deck was assumed. Full composite action was too much, and optimal results were obtained by averaging the results from the non-composite case and the fully composite case.

8. Since the measured and calculated stress ranges were less than the fatigue threshold, it is concluded that fatigue cracking is not expected in the deck truss of this bridge.

9. Live-load stress ranges greater than the fatigue threshold can be calculated if the AASHTO lane loads are assumed. The actual measured stress ranges are far less primarily because the loading does not frequently approach this magnitude. While the lane loads are appropriate for a strength limit state (the loading could approach this magnitude a few times during the life of the bridge), only loads that occur more frequently than 0.01% of occurrences are relevant for fatigue. For this bridge with 15,000 trucks per day in each direction, only loads that occur on a daily basis are important for fatigue.

The following actions are recommended:

1. The members of the main truss with the highest stress ranges are U2L3, L3U4 and U4U6. These members should be inspected thoroughly, especially at the ends of the "clips" on the diaphragms in the tension members and at any intermittent fillet welds. These members should be inspected every two years as is presently done.

2. The lower chords and diagonals of all the floor trusses also have high stress ranges. The ends of the "fin" attachments reinforcing the splice welds are the most critical locations. Since these can be inspected easily from the catwalk, they could be inspected every 6 months.

CHAPTER 8

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Minnesota Department of Transportation

Memo

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bob.miller@dot.state.mn.us

March 7, 2003

To: Consultants
FY 02/03 Bridge Design List
Category 4- Bridge Studies

From: Robert J. Miller
Bridge Agreements Engineer

Subject: Fatigue Evaluation Bridge 9340
TH 35W over Mississippi River, in Minneapolis
Request for Interest (RFI)

The Minnesota Department of Transportation's (Mn/DOT) Office of Bridges and Structures is soliciting expressions of interest from qualified engineering firms to undertake a special study to evaluate the fatigue characteristics of various fracture critical members of the truss-arch superstructure for Bridge 9340. The bridge's three main spans consist of a non-redundant deck truss-arch system. The approach spans are primarily welded steel girders. The truss-arches cantilever over Piers 5 and 8 to an expansion joint where the approach girders are framed into end floor beams. **The study will focus on the truss-arch spans.**

The study's primary objective is as follows:

1. Identify the main superstructure members of the truss-arch spans that are most susceptible to fatigue cracking and evaluate the structural consequences should one of those members fail.
2. Determine repair methods for fatigue cracks.
3. Identify preferred staging of deck replacement to minimize stresses in the bridge.

All firms qualified to perform Category 4, Bridge Studies, on Mn/DOT's list of Bridge Design Contractors for Fiscal Years 2002/2003 will receive this solicitation.

PROJECT OVERVIEW

The project goal is to identify structural members of the truss-arch spans that are most susceptible to cracking, identify the most critical members, and evaluate how the bridge would perform if any one of those critical members were removed. The project will evaluate how dead and live loads are redistributed in the bridge when failure occurs in the critical members and if/how adjacent members will fail when the loads are redistributed. The project will identify repairs to critical members and identify a preferred deck replacement staging in the truss-arch spans. The analysis will concentrate on the truss-arch portion of the bridge.

Under a previous agreement Dr. Robert Dexter of the University of Minnesota conducted a fatigue analysis study titled ***Fatigue Evaluation Of The Deck Truss Of Bridge*** *9340. The study was to determine the actual live load stresses the bridge experiences. The SAP 2000 program was utilized for the analysis. Results of that work will be incorporated into this study. During final contract negotiations between Mn/DOT and the successful respondent it will be mutually determined whether a subconsultant agreement with the University is required or if a simple transfer of data, model, etc is adequate.*

ANTICIPATED WORK TASKS

The following minimum work tasks are anticipated. Final tasks will be determined during contract negotiations with the successful respondent.

TASK 1 DATA COLLECTION

1.1 Consultant will assemble bridge inventory data and history including bridge plans, bridge structural members sizes and connection details, piling reports, shop drawings, material records, traffic history, and condition history from bridge inspection reports. Mn/DOT will arrange for consultant to review records from the Mn/DOT Records Center and Bridge Office files but consultant will be responsible for assembling necessary materials.

TASK 2 THREE-DIMENSIONAL MODEL – DEVELOP AND CALIBRATE

2.1 Consultant will develop a three-dimensional space frame model of the bridge or modify the University's model. The model will include all truss-arch members, floor beams, stringers, lateral bracing, sway bracing, concrete deck, and other elements which may be acting as part of the overall structural system, including the approach span girders and diaphragms.

2.2 Consultant will survey and monitor the thermal movement of the bridge at bearings, joints, and piers.

2.3 Consultant will calibrate its three-dimensional model with results of data obtained from the University of Minnesota's study.

TASK 3 STRUCTURAL EVALUATION

3.1 Consultant will utilize the calibrated three-dimensional model to evaluate structural members of the truss-arch spans under dead, live, and thermal load conditions. The live loads will be based on up to five vehicles identified by Mn/DOT.

3.2 The evaluation will identify critical structural members in the truss-arch spans with high likelihood of fatigue failure. ***Mn/DOT assumes a minimum of eight critical members to be identified.*** Consultant will determine the most likely locations for cracks to initiate for each critical member identified. Consultant will design contingency repair sketches for each critical member to be utilized by Mn/DOT if/when such cracks are discovered.

3.3 Consultant will re-analyze the arch-truss spans under member failure conditions. A re-analysis will be performed with each identified critical member individually removed. Mn/DOT assumes no more than one member failure will occur in any single event. The re-analyses will determine if the bridge will completely fail when an element fails and is removed or if stresses are redistributed to other members.

3.4 Consultant will estimate the remaining fatigue life in the main members of the truss-arch spans.

TASK 4 DECK REPAIR STAGING PLAN

4.1 Consultant will identify a preferred staging scheme to be used if/when the bridge is redecked. The scheme will minimize the stresses in the critical members. The scheme will be based on current deck geometry.

TASK 5 FINAL REPORT

5.1 Consultant to prepare a final report detailing the following:

- Observed thermal movements of the bridge.
- Brief discussion of existing bearing and joint performance.
- Recommendation on necessity of bearing revisions and methods of accomplishing repairs.
- Brief discussion of data gleened from U of M study that impacts the analysis.
- Live load configurations used in the evaluation.
- Identification of at least eight critical members and reasons for their criticality.
- Results of the re-analyses for critical member removals.
- Fatigue repair sketches.
- Remaining fatigue life of truss-arch span members.
- Deck replacement staging.

Paul Kivisto of the Office of Bridges and Structures will be Project Manager. Bob Miller will be Consultant Coordinator.

PROJECTED DELIVERABLES AND TIMELINE

Three copies of the final report and one copy of the structural assessment calculations. Interim project status meetings will be held to discuss preliminary findings and to discuss project assumptions. **It is assumed an agreement will be executed and work started in May 2003. All work will be completed within 16 months of contract execution.**

INSTRUCTIONS TO RESPONDERS

If interested, ***please respond by fax, e-mail, or in writing no later than 3:00 PM, March 28, 2003***, to Bob Miller at the address or fax number shown in the letterhead. Responses to include a one page transmittal letter, a one page resume for each key personnel, and no more than four additional pages (i.e. if three key personnel are identified the total proposal can be seven pages plus a transmittal letter). A positive response of interest is automatic confirmation that qualified personnel are available and are capable of delivering the required services and meeting the timeframe defined above. The project manager and key support personnel, **including fatigue personnel**, must be identified. Briefly describe up to three projects for which your firm and key personnel has recent relevant bridge analysis experience. Preference will be given to firms that identify a team with similar structural analysis experience on complex bridge projects.

THIS RFI IS NOT A REQUEST FOR PROPOSAL.

Mn/DOT will select from among the firms that respond to this RFI and will request a complete financial proposal from the selected firm. Mn/DOT reserves the right to interview responding firms.

Bridge plans are available for review at the Mn/DOT Office of Bridges and Structures.
For technical questions, please contact Bob Miller, at (651) 747-2105 or Paul Kivisto, at (651) 747-2130.

ST

FATIGUE EVALUATION BRIDGE 9340
TH 35W OVER MISSISSIPPI RIVER, IN MINNEAPOLIS

Submitted to

Minnesota Department of Transportation,
Office of Bridges and Structures

Submitted by

HNTB

March 28, 2003

HNTB ARCHITECTS ENGINEERS PLANNERS

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March 28, 2003

Mr. Robert J. Miller, P. E.
Bridge Agreements Engineer
Office of Bridges and Structures
Minnesota Department of Transportation
3485 Hadley Avenue North
Oakdale, MN 55128-2108

Re: Fatigue Evaluation Bridge 9340 - TH 35W over Mississippi River, in Minneapolis
Response to Request for Interest

Dear Mr. Miller:

HNTB is excited about the opportunity to provide professional services for the fatigue evaluation of Bridge 9340. This is exactly the type of project that HNTB excels at – resolving a complex bridge analysis into practical solutions. As you read our response, you will see that HNTB offers extensive and complementary experience with projects similar to yours. Please consider this submittal as HNTB's affirmative response to your March 7 Request for Interest.

- **HNTB has the complex bridge analysis experience and tools required for this project.** Mike Speedling and Rich Johnson have completed complex, three-dimensional, large defection (failure) analyses on the Lake Street Steel Alternate as well as the Hennepin Avenue Suspension Bridge utilizing HNTB's proprietary bridge analysis software. Don Kruse, who authored this program, will provide review and consultation throughout the project.

- **The HNTB team has the required fatigue/fracture expertise needed to evaluate Bridge 9340.** Robert Dexter and Stan Rolfe provide Mn/DOT with national experts in fatigue design and fracture mechanics.

- **HNTB offers a unique combination of experience ranging from research professionals to practicing bridge engineers.** Maury Miller brings more than 35 years of bridge design experience. Steve Olson's research experience, coupled with his design and inspection expertise, uniquely qualify him for this project. Our team will provide Mn/DOT meaningful conclusions and viable solutions derived from complex theoretical models.

- **HNTB will develop constructible and cost-effective solutions**. Repair concepts and deck replacement strategies will be evaluated by Jack Sehlin. Jack brings practical application to the project that can only be gained through his 50 years of bridge construction experience, including construction of Bridge 9340.

As you know, we have been thinking about this project for more than two years. We understand that this bridge is not only a fracture critical bridge, but also a critical link in the Metro transportation system. HNTB offers the most qualified team to address Bridge 9340.

Sincerely,
HNTB Corporation

Richard M. Johnson, P. E.
Associate Vice President

The HNTB Companies

OFFICES: ALEXANDRIA, VA; ANNAPOLIS, MD; ATLANTA, GA; AUSTIN, TX; BATON ROUGE, LA; BOSTON, MA; CHARLESTON, SC; CHARLESTON, WV; CHICAGO, IL; CLEVELAND, OH; COLUMBUS, OH; DALLAS, TX; DENVER, CO; DETROIT, MI; ELKINS, WV; FT. WORTH, TX; HARTFORD, CT; HICKSVILLE, NY; HOUSTON, TX; INDIANAPOLIS, IN; KANSAS CITY, MO; KNOXVILLE, TN; LANSING, MI; LOS ANGELES, CA; LOUISVILLE, KY; MADISON, WI; MIAMI, FL; MILWAUKEE, WI; MINNEAPOLIS, MN; NASHVILLE, TN; NEW YORK, NY; OAKLAND, CA; ORANGE COUNTY, CA; ORLANDO, FL; OVERLAND PARK, KS; PHILADELPHIA, PA; PORTLAND, ME; PORTLAND, OR; RALEIGH, NC; ST. LOUIS, MO; SALT LAKE CITY, UT; SAN ANTONIO, TX; SAN BERNARDINO, CA; SAN FRANCISCO, CA; SAN JOSE, CA; SEATTLE, WA; TAMPA, FL; TOLEDO, OH; WAYNE, NJ; WASHINGTON, DC.

Project Understanding

Bridge 9340 is a fracture critical truss-arch carrying I-35W over the Mississippi River in Minneapolis, Minnesota. Approach spans are primarily welded steel plate girders. A preceding study by Dr. Robert Dexter and Heather O'Connell, *Fatigue Evaluation of the Deck Truss of Bridge 9340* (August 2000), will be incorporated into this study.

The objectives of this project are to identify superstructure members most susceptible to fatigue, evaluate alternate load paths in the event of a failure of a susceptible member, develop repair concepts for repair of fatigue cracks and identify preferred staging of deck replacement.

Qualifications

Rich Johnson will serve as project manager. Rich has served as project manager/director for several large multidiscipline projects including the Hiawatha LRT Tunnel, the Wakota Bridge and the Hell Canyon Bridge. Rich brings an extensive background in Mn/DOT bridge design and structural analysis.

Robert Dexter and Stan Rolfe bring the best bridge fatigue/fracture expertise available in the United States. Robert is, of course, thoroughly familiar with Bridge 9340 from prior studies conducted for Mn/DOT. Stan Rolfe brings more than 33 years of experimental and analytical fracture mechanics research.

Steve Olson has worked on multiple steel truss bridges, including both new designs and rehabilitations. He developed software to perform second order analysis for suspension bridges similar to the analysis required for the failure analysis for Bridge 9340. Steve currently directs the MAST Laboratory at the University of Minnesota.

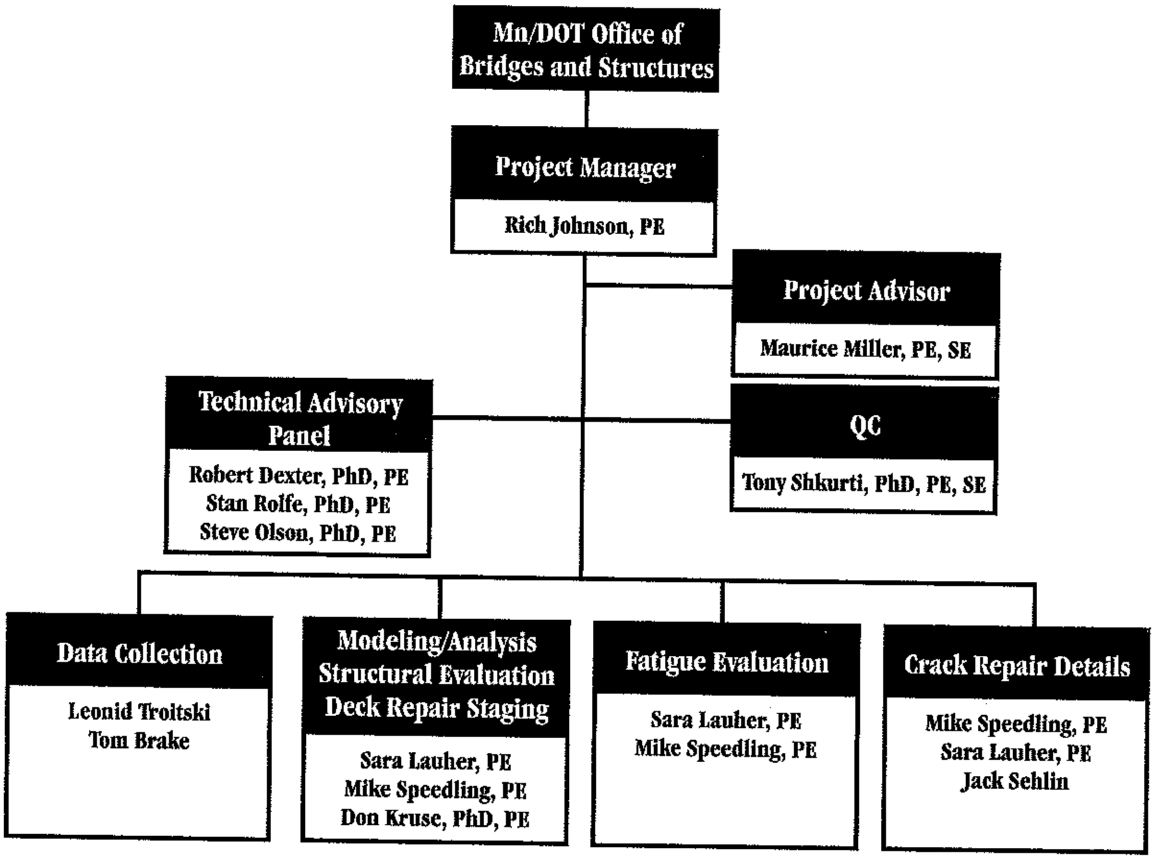
Maury Miller, with more than 40 years of complex bridge design experience, will serve as project advisor. Tony Shkurti will conduct a QC review. Tony recently completed a non-linear, three-dimensional modeling, analysis and fatigue/fracture evaluation for the Menomonee Valley Bridge in Milwaukee.

Mike Speedling and Sara Lauher will conduct the modeling and analysis with assistance from Tony Shkurti and Don Kruse. In addition to extensive experience with conventional analysis, Mike Speedling has performed complex analysis on five bridges, including truss and arch bridge types. Mike conducted the large deflection analysis for the Lake Street/Marshall Avenue Steel Alternate. This is very similar to the analysis required for Bridge 9340. Sara conducted the time-dependent analysis for the Wakota Bridge utilizing HNTB analysis software.

Don Kruse will provide guidance on modeling and analysis. In addition to authoring HNTB's in-house structural analysis software for bridges, Don has taught Matrix Structural Analysis and Advanced Numerical Methods at the University of Kansas and the University of Missouri.

Jack Sehlin will evaluate proposed retrofit details for constructibility and provide construction input regarding deck staging. Jack offers 50 years of bridge construction experience, including construction of Bridge 9340. If requested, Jack is also available to develop construction cost estimates for proposed details.

More detailed resumes follow this section.



Complex Bridge Analysis Experience

Menomonee Valley Bridge Investigation, Milwaukee

A non-linear, three-dimensional analysis was conducted to assess fatigue and fracture for a 3,400-foot plate girder bridge in Milwaukee, Wisconsin. This state-of-the-art study was undertaken to detect and document current vulnerability of the structure, and develop short-term and long-term rehabilitation plans. Tony Shkurti was responsible for this work while employed with another firm.

Hell Canyon Bridge, South Dakota

A three-span deck truss (552 feet, 760 feet, 552 feet), with girder approaches will carry US 16 over a deep canyon near Custer, South Dakota. A three-dimensional model was used to analyze and design the fracture critical truss. The flexibility of the tall piers was incorporated into the superstructure model. Rich Johnson, Maury Miller and Steve Olson were involved in this project.

Lake Street/Marshall Avenue Steel Alternate, Minneapolis/St. Paul
A three-dimensional, non-linear (large deflection) model was developed to evaluate global stability of the long-span steel arch. Stability was evaluated for multiple erection configurations and the final condition. Stringers, bracing, spandrel columns, diaphragms and flexible support conditions were incorporated into the model. The interaction of the concrete deck was also considered for the evaluation of the completed structure. Eigenvalue solutions were also determined to compare to the large deflection results. Stress levels of secondary members were also evaluated. Mike Speedling conducted this analysis with assistance from Don Kruse and review by Maury Miller.

Project Approach

The type of analysis required to assess the performance of Bridge 9340 in the event of a member failure is very different from the conventional small displacement (first order) analysis. Large deflection analysis is performed by incrementally loading the structure and reassembling the stiffness matrix for each time step in the deformed position to account for geometric non-linearity. At each iteration of the analysis, the structure may reach equilibrium, where displacements are within the first order threshold, or become unstable (singular stiffness matrix). Because the process is iterative and errors are cumulative with each time step, numerical methods and precision become far more significant than for single step solutions. If stress levels are high enough, non-linear material properties may also need to be included in the model. The validity of boundary conditions, member end conditions, composite action and other factors all become far more critical for second order analysis.

HNTB will collect and review existing information for Bridge 9340, including inventory data, bridge plans, shop drawings, traffic history and inspection reports. All of the available material will be considered to assess structural significance.

The bridge will be instrumented and monitored for thermal movements. Results of the thermal monitoring will be used to input appropriate boundary conditions into the structural model at the supports. Substructure and superstructure thermal displacements will be measured at pier locations. Both the truss displacement and the approach girder displacement will be measured at the joint locations. Rotation and translation spring constants at support locations will be determined from measured thermal movements. Highly qualified survey personnel and high precision survey equipment will be utilized for these measurements.

A three-dimensional model will be developed and calibrated to live load stresses from the Dexter study and the observed thermal movements. The model will include all truss-arch members, floor beams, stringers, lateral bracing, sway bracing, concrete deck, approach girder and diaphragms and other elements that may be acting as part of the overall structural system.

HNTB analysis software (T187) will be utilized for structural analysis. This program may be used to model and analyze any structure that consists of a stable combination of cable, frame or truss-type members. Dynamic, large deflection, seismic and stability analysis can all be performed with the program. An automatic live load generator is included in the program. The T187 was developed by Don Kruse in 1980 and has been in used on hundreds of HNTB projects throughout the world. SAP 2000 input files may be conveniently translated into T187 input data.

Results of the calibrated model will be used to identify high-stress members. Critical locations will be determined by considering stress levels in combination with the fatigue susceptibility of the member detail. At least eight critical members will be individually removed from the model to assess the capacity of the bridge in the event of a failure of these members. The boundary conditions determined from service loads may change after a member failure. Support conditions will be re-evaluated for the failure analysis.

Contingency repair sketches will be prepared for each critical member. If requested, HNTB will estimate construction costs associated with the repair schemes based on the work analysis method.

HNTB will estimate the remaining fatigue life of the primary members. NCHRP Report 299 will be used for the fatigue evaluation. Nominal stress ranges, based on the calibrated model, will be compared to the S-N curve for the type of detail found at a particular location to determine the number of cycles to failure. The constant amplitude stress range will be derived from the measured service load stress history using Miner's Rule. Both the derived constant amplitude stress range and the measured stress range from the known test live load will be compared to the constant amplitude fatigue limit. Remaining life may be calculated based on estimated future truck volume and estimates for previous load cycles.

Deck replacement will be considered to determine a staging scheme that minimizes stresses in critical members.

RICHARD M. JOHNSON, PE

Firm

HNTB

Education

BS, Civil Engineering, University of Minnesota

Registrations

Professional Engineer: Minnesota, Wisconsin, South Dakota

Years of Experience

22

Experience

Rich joined HNTB in 1982 and presently heads the Bridges and Structures Design Department in the HNTB Minneapolis office. He has served as project manager on several multi-million dollar projects that required coordination of disciplines, historic properties and environmental documentation. Rich presently serves on Committee 15 (Steel Structures) of the American Railway Engineering and Maintenance-of-Way Association (AREMA). Some of Rich's project experience includes:

Hell Canyon Bridge, Custer, SD

Project manager for this bridge type study, preliminary and final design of a 2,000-foot-long fracture-critical steel deck truss bridge within the Black Hills of South Dakota. Estimated construction cost is $31 million. This bridge includes an 760-foot main span and was designed to address fatigue concerns associated with zone 3 fracture-critical structures.

Soo Line Bridge 424-A, Somerset, WI

Rich served as the design engineer on the inspection, rating, fatigue analysis and structural evaluation of a 2,700-foot long steel trussed arch railroad bridge built in 1910 and listed on the National Register of Historic Places.

Hennepin Ave. Suspension Bridge Failure Analysis, Mpls. MN

Rich served as the project manager and design engineer to evaluate the effects of alternative loading (sabotage) on this fracture-critical highly indeterminate structure. The failure analysis included modeling time-dependent, non-linear geometry and material properties, as well as modeling "tension-only" members, through incremental failure analysis as individual members were removed to predict the effects on the stability of the structure. The failure analysis was completed with HNTB's T-187 structural analysis software.

Burlington Northern Bridge No. 9, Minneapolis, MN

Rich served as project engineer for the above and inspection, structural and fatigue analysis, rating and development of remedial measures to place this 950-foot, two-span steel deck truss bridge back into service. Rich conducted the underwater inspection of the bridge.

Stillwater Lift Bridge, Stillwater, MN

Rich is serving as project manager for the inspection and evaluation of a historic movable lift bridge, including condition rating and load ratings and implementation of renovation plans.

Duluth Aerial Lift Bridge, Duluth, MN

Served as design engineer for structural inspection, analysis, rating and plan development for the bridge rehabilitation. The bridge is a regional landmark and listed on the National Register of Historic Places.

Glen Park Suspension Bridge, River Falls, WI

Rich served as project manager on the inspection and development of rehabilitation plans and construction services for a 65-year old suspension bridge for the City of River Falls.

MAURICE D. MILLER, PE, SE

Firm

HNTB

Education

MS, Structural Engineering, University of Kansas
BS, Civil Engineering, Iowa State University

Registrations

Professional Engineer: Minnesota, Iowa, Michigan, Colorado, Washington, California, Missouri, Florida, Texas, Tennessee
Structural Engineer: Illinois, Arizona

Years of Experience

45

Experience

Mr. Miller, an HNTB Vice President who joined the Kansas City Office in 1958, is Chief of Bridge Design and Special Projects. His current or recent assignments have included the following:

Mississippi River Bridge, Washington County (Greenville), Mississippi - Chicot County, AR

Responsible for preliminary design and plans for steel and concrete cable-stayed alternates for a new Mississippi River Bridge.

Mississippi River Bridge, Cape Girardeau, MO

Project manager responsible for type studies, preliminary plans, and final design and plans (steel and concrete cable-stayed alternates) for a new 1,150-foot span over the Mississippi River.

Fuller Warren Bridge, Jacksonville, FL

Responsible for development of the preliminary engineering report for a study that evaluated multiple alternatives for repair/replacement of the I-95 bridge over the St. John's River.

Eads Mississippi River Bridge, St. Louis, MO

Provided quality assurance and construction engineering review for rehabilitation of the historic bridge to accommodate light rail transit.

Alsea Bay Bridge, Waldport, OR

Conceptual and preliminary design and plans for $42.4 million, 2,910-foot replacement bridge in an environmentally-sensitive area. Lead designer for selected steel arch alternate. Original bridge is an historically-significant structure which is the focal point in the scenic backdrop of the Waldport Community.

Hennepin Avenue Mississippi River Bridge, Minneapolis, MN

Structural design for a $25.6 million, 625-foot suspension bridge connecting the Central Business District to Nicollet Island, within the St. Anthony Falls Historic District.

Roosevelt Lake Bridge, Gila County, AZ

Design of the 2,000-foot steel alternate for a new bridge in extremely rugged terrain.

Mississippi River Bridge, Marquette, IA to Prairie du Chien, WI

Design of plans for emergency repairs to fracture-critical tie girders.

DONALD KRUSE, PHD, PE

Firm

HNTB

Education

PhD, Mathematics; University of Kansas
MS, Engineering; University of Kansas

Registration

Professional Engineer: Kansas

Years of Experience

24

Experience

Dr. Kruse joined HNTB in 1978 and worked for 10 years as a bridge designer before transferring to the firm's Technology Office (formerly Technical Computer Systems) in 1988. He is responsible for dynamic structural analysis of major projects and serves as a liaison engineer between the structural engineering and computer departments on the development of in-house programs for complex structural design and analysis. Dr. Kruse taught an advanced numerical methods course for the University of Kansas engineering department and taught a Matrix Structural Analysis course at the University of Missouri in Kansas City. Prior to joining HNTB, Dr. Kruse taught mathematics at the University of Kansas for 10 years.

Since joining the firm's Technology Office, Dr. Kruse has been instrumental in the development of several applications, including the following:

T187 – T187 is a matrix structural analysis program based on the direct stiffness method. This program is used for erection analysis of concrete and steel structures, including creep and shrinkage of the concrete. Dr. Kruse also added dynamic time history analysis for earthquake analysis to this program.

Bridge Design System --Designed software system for design, analysis, and graphics generation of bridge details.

While working as an engineer, Dr. Kruse gained extensive bridge experience from projects including:

Roosevelt Lake Bridge, Gila County AZ

Aerodynamic analysis for a 2,000-foot steel arch bridge (1,200-foot main span) in rugged terrain.

Lake Street/Marshall Avenue Mississippi River Bridge, Minneapolis, MN

Erection analysis of arch, spandrels and deck.

Alsea Bay Bridge, Waldport, OR

Computer analysis of erection of arches and delta piers.

Neches River Bridge, Port Arthur, TX

Design check involving computer modeling for analysis of aerodynamic stability of concrete cable-stayed bridge.

Mississippi River Bridge; Natchez, Mississippi-Vidalia, LA

Computer modeling for a cantilevered truss bridge with five river spans, including a 798-foot center span.

Mississippi River Bridge, Sioux City, IA

Involved in developing an analysis of repair procedures for a tied arch bridge.

TONY F. SHKURTI, PHD, SE, PE

Firm

HNTB

Education

PhD, Civil Engineering, University of Illinois at Urbana-Champaign
MS, Civil Engineering, Wayne State University
BS, Civil Engineering, University of Tirana, Albania

Registrations

Professional Engineer: Illinois
Structural Engineer: Illinois

Years of Experience

15

Experience

Menomonee Valley Bridge Investigation, Wisconsin Department of Transportation, Milwaukee, WI

Structural engineer responsible for the non-linear 3-D modeling, analysis, and fatigue and fracture evaluation of the typical connection framing using ABAQUS. The bridge comprises 3,400 foot of multiple continuous welded girder spans, and possesses framing and lower-lateral bracing details typical to the era of its design which have since been revealed as potential concerns for both fatigue and fracture. This state of the art study was undertaken to detect and document the current vulnerability of the structure, and to compile near-term and long-term plans for maintenance and rehabilitation actions to extend the life of the structure. Finite element modeling, sub-modeling, and field instrumentation data were combined and compared with available literature and the collected experience of the bridge community in the subject. Conclusions and recommendations are being summarized in a detailed report to WisDOT.

Torrence Avenue SPUDI, Composite Steel Girder Alternate, Illinois Department of Transportation

Structural project engineer responsible for the design and plan preparation for these composite steel girder structures. Responsibilities included preliminary conceptual design, fatigue and strength analysis and design for the girders framing into each other and the respective connections. Responsibilities also included preparation of life-cycle estimates for the different alternates, estimate of the hours needed to complete analysis, design and plan preparation. The SPUDI comprises five bridges separated by expansion joints. Mainline Torrence Avenue structure includes very complex geometry that has flaring ramps framing into the main structure. Four more structures make up the four ramps bringing traffic to Torrence Avenue.

Kernville Viaduct (S.R. 0056), Pennsylvania Department of Transportation

Senior structural engineer for the final design of the reinforced concrete substructure and steel straight and curved girder superstructure for the rehabilitation/replacement of a 27-span, curved multi-girder steel viaduct. A thorough fatigue evaluation of the proposed curved girders was carried out.

MIKE SPEEDLING, PE

Firm

HNTB

Education

BS, Civil Engineering, University of Minnesota

Registration

Professional Engineer: Minnesota

Years of Experience

18

Experience

Mike is a registered professional engineer with more than 18 years of experience on a variety of projects including bridges, tunnels and other structures. This experience includes highway, railroad, aircraft and pedestrian structures. Bridge types include prestressed concrete girders, steel plate girders, steel trusses, post-tensioned concrete slabs, steel box girders, steel and concrete arches, suspension and segmental concrete box girders. Some of his most recent project experience includes:

Ramp D over I-275, Tampa, FL

Lead design engineer for this project. Ramp D is a three-unit, steel plate girder bridge. This eight-span bridge is more than 1,200 feet in length. A curved alignment and highly skewed supports required finite element analysis. Mike designed the superstructure and a post-tensioned concrete straddle bent.

Ramp G-4, Tampa, FL

This bridge is a curved, four-span, steel plate girder structure with highly skewed supports and unbalanced span lengths. Mike served as lead design engineer and designed superstructure and piers. Finite element analysis was used to determine live load distribution and forces in secondary members. The Florida Department of Transportation was the client for this project.

St. Croix River Bridge, Stillwater, MN

During the Type Study phase, Mike evaluated steel and concrete arches and participated in the public involvement process. During final design, Mike designed curved shell concrete pier columns for the segmental concrete alternate.

A new bridge was required over the St. Croix River near Stillwater, Minnesota. Alternate foundations were designed for drilled piers and cast-in-place piles. The foundations were evaluated for multiple load cases for balanced cantilever construction. This project was completed for the Minnesota Department of Transportation.

Mn/DOT Bridge No. 27789, St. Louis Park, MN

This eleven-span bridge provides a connection between I-394 eastbound to TH 100 southbound. Bridge geometry is complex because the deck widens and bifurcates. Integral steel, outrigger type pier caps were required to straddle the frontage road below. Mike designed superstructure and pier columns for this Minnesota Department of Transportation project.

Lake Street/Marshall Avenue Steel Alternate, Minneapolis-St. Paul, MN

This twin, 550-foot arch bridge over the Mississippi River was designed for the Minnesota Department of Transportation. Mike performed a three-dimensional, large deflection analysis and a stability analysis. The model included arch ribs, lateral bracing members, spandrel columns, stringers, diaphragms and the concrete deck. In addition to analysis of the completed bridge, multiple configurations for different erection steps were evaluated.

SARA L. LAUHER, PE

Firm

HNTB

Education

MS, Civil Engineering, Purdue University, West Lafayette, Indiana
BS, Civil Engineering, Purdue University, West Lafayette, Indiana
BS, Mathematics, University of Florida, Gainesville, Florida

Registration

Professional Engineer: Minnesota

Years of Experience

4

Experience

Sara is a structural engineer with four years of experience in design and a master's degree in Civil Engineering. Prior to embarking on a career in engineering, she spent about two years as an actuary, consulting directly with clients on a regular basis and managing pension plans. Her relevant experience encompasses a variety of assignments ranging from development of detailed designs and plan production to participation in construction services and supervision of engineers and technicians. Ms. Lauher also has experience in evaluation of structure types and structure configurations based on technical as well as economic considerations.

Wakota Bridges Nos. 82855, 82856, St. Paul, MN

Sara served as design engineer on these two segmental concrete box girder bridges for the Minnesota Department of Transportation. These bridges are each five spans and will replace the existing crossing of Interstate 494 over the Mississippi River. Her responsibilities included design of the parapet type abutments and the design of the transverse post-tensioning of the superstructure. She used T-187 for the transverse post-tensioning design which was complicated by an asymmetrical constant width deck overhang and flared geometry at the abutments. Sara's duties on the Wakota Bridges included supervision of the plan production and coordination with sub-consultants.

Experience Prior to HNTB:

Railroad Bridge over Highway 100, Hennepin County, MN

Sara performed preliminary design on this 4-span bridge. She optimized the steel plate girder design and designed a through-plate girder for CP Rail.

SR 594 and SR 693 Interchange, Pinellas County, FL

Sara designed a steel monotube signalization structure for the Florida Department of Transportation. This 32-inch diameter tube spans 224-feet diagonally across an intersection.

Graduate School, Purdue University, IN

Sara attended a Finite Elements class which included modeling of both 2-D and 3-D elements by hand and with SAP 2000. Sara also attended a Behavior of Metal Structures class that included topics on fracture mechanics, fatigue mechanisms and testing and fatigue crack propagation.

LEONID (LEO) S. TROITSKI

Firm

HNTB

Education

St. Petersburg Marine Academy, Russia

MS, Survey, Hydrography and Navigation, St. Petersburg Marine Academy, Russia

Years of Experience

22

Experience

Leo has more than 20 years of worldwide expertise in construction works, tunneling, land survey, oil and gas prospecting, geological survey, prospecting and mining of mineral raw materials. Some of his experience includes:

LRT Tunnels and Station, Minneapolis, MN

Leo is providing quality assurance (QA) oversight inspection of excavation, concrete work and finishing of a system of two open cut and cut & cover portals, mining (EPBM) of two tunnels (soft rock), and underground station with two ventilation shafts and access to the airport terminal.

The project consists of the construction of two tunnels under the airport for future Light Rail. This included obstruction analysis of at and above grade features, construction staging and coordination with other airport construction activities.

In addition to daily QA inspection, position require: reviewing of submittals pertaining to survey and settlement monitoring activities, participation in meetings related to these issues with contractor's representatives. His responsibilities also included: developing and maintaining the survey part of QA program, performing: verification survey (field and office work) of contractor's vertical and horizontal survey monuments, settlement monitoring data collection, processing, interpretation and record keeping. Leo also participated in setting up the project database for variety of construction data collection, statistical analysis and graphical representation in form of Excel spreadsheets and graphs.

Tren Urbano Project, Rio Piedras, Puerto Rico

While with Kiewit-Kenny-Zachry AJV, Leo served as survey manager and provided direct oversight to the project survey department. His duties included supervising daily activities of four survey crews, including mining and concrete work of two TBM and four NATM tunnels, two cut and cover structures and two subway stations (One cut and cover and one underground). Maintaining and developing of existing survey monuments network (2 miles) for the project (Survey software "Cogo PC, StarNet adjustment software). Leo supervised extensive settlement monitoring program (Project located at and under downtown San-Juan). He also provided project drawing and documentation review and coordination, alignment data verification, as-built of tunnels and structures, using unique Profiler-4000 equipment set and "Prowin" software.

DART Light Rail Project, Dallas, TX

While with S.A. Healy Co., Leo served as survey party chief responsible for survey pre-calculations, layout and as-built survey ("Wild" profiler) for tunneling and open cut excavation. Settlement monitoring during the tunneling and excavation. He provided the survey support of the concrete work for the underground station and also for the excavation and concrete work for the parking lot and a pedestrian bridge.

THOMAS E. BRAKE

Firm

HNTB

Education

Municipal Engineering, St. Cloud Technical College, St. Cloud, Minnesota
General Courses, University of Minnesota, Morris, Minnesota

Years of Experience

21

Experience

As HNTB Minneapolis' senior survey crew chief, Tom has more than 20 years experience and has worked on a wide variety of assignments including bridges, tunnels, airports, subdivisions and other construction and design related projects. He also has more than seven years of CADD experience. Tom has done photo control surveys using GPS equipment and used metric micrometers for tenth of a millimeter accuracy on elevation surveys. Tom works with the contractors to perform the construction survey coordination. Tom also has performed quantity calculations for many of the projects. Representative project experience includes:

ALSF-2 Light Support Bridge over I-494, Bloomington, MN

Tom was involved with the design surveys as well as the alignment and construction staking for the ALSF-2 Light Support Bridge over I-494 in Bloomington. The bridge supports the runway landing lights for the new RWY 17-35 at Minneapolis-St Paul International Airport.

TH 212 Design-Build Preliminary Engineering Design, Eden Prairie, MN

Tom was one of two crews that performed utility and design surveys for all of the existing streets and roads where they cross the proposed new alignment of TH 212. He was also in charge of downloading and reducing the 15,000 or so survey points to a Microstation drawing so the base maps could be updated to existing conditions.

LRT Tunnel, MSP International Airport, Minneapolis, MN

Tom and his crew did extensive surveys on the alignment corridor to verify locations of topographic features and underground utilities. He also used GPS to set up the horizontal and vertical control for the project. A Robotic Geodimeter Total Station was used to survey the runways and aprons at night. During construction, Tom and his crew are responsible for monitoring settlement in critical areas with tenth of a millimeter accuracy. He is also involved with checking the contractor's survey for accuracy.

Glen Park Suspension Bridge, River Falls, WI

Tom was responsible for the condition survey and CADD operation on a 65-year old suspension bridge for the City of River Falls.

STEVEN A. OLSON, PHD, PE

Firm

HNTB

Education

PhD, Civil Engineering, University of Minnesota - Twin Cities, Minnesota
MS, Civil Engineering, University of Minnesota - Twin Cities, Minnesota
BS, Civil Engineering, University of Minnesota - Twin Cities, Minnesota

Registration

Professional Engineer: Minnesota, Ohio

Years of Experience

16

Experience

Steve is a registered professional engineer with more than 15 years of structural engineering experience as a designer, inspector, analyst, researcher, manager, and educator. This experience includes full scale structural testing, the development of structural analysis software, and a variety of bridge related projects on both a system and individual project level. Some of his most recent project experience includes:

Hell Canyon Bridge, Custer County, SD

Designed the substructure units and performed an independent review of the superstructure. A winding canyon road on US 16 will be bypassed when the Hell Canyon Bridge is completed. The structure will have two short girder spans flanking a three-span continuous deck truss (spans of 66, 552, 760, 552 and 66 feet). Steve is designed the substructure units and performing an independent review of the superstructure. The client for this project is the South Dakota Department of Transportation.

12th Avenue Bridge, Fargo, ND

Steve is project manager for a project evaluating the current condition of the 12th Avenue Bridge over multiple sets of BNSF railroad tracks in Fargo, North Dakota. The 29 span structure was constructed in 1978. It has 22 spans supported on prestressed I-beams and 7 spans supported on steel plate girders. After the current condition is assessed, multiple rehabilitation schemes will be developed for the client to consider. This project involves railroad coordination and the management of three subconsultants. Client: North Dakota Department of Transportation.

1st Street South Bridge, Minneapolis, MN

The replacement structure for the 1st Street South Bridge in the St. Anthony Falls National Historic District of Minneapolis is a steel through-girder bridge. The new simple span bridge reused floor beams and one of the abutments from the prior structure. An abutment with extensive architectural treatments and an ornamental railing were incorporated into the new structure. Steve performed construction engineering services. The client for this project was the City of Minneapolis.

Kwang An Grand Bridge, Pusan, Korea

Steve was the analysis coordinator for a team of engineers evaluating the towers, stiffening truss and anchorages of a 900-meter (2,953-foot) suspension bridge. The three-span, double decked structure has a main span of 500 meters (1,640 feet). The client for this project was the Dong Ah Construction Industrial Company.

Programs LDA-TRUS and LDA-LOAD (software development)

To accurately load rate suspension bridges, Steve developed in-house software. The programs perform second-order (geometrically nonlinear) analyses based on the stiffness method. The initial strain offsets between members, thermal loadings and a truck load generator were incorporated into the software. The programs were used on four suspension bridges with main spans over 600 feet.

JACK SEHLIN

Firm

Sehlin Consultants

Education

BS, Civil Engineering, University of Minnesota

Years of Experience

50

Experience

Jack has 50 years of experience in all facets of bridge construction including estimating, scheduling and other aspects of construction management. From 1981 through 1997, Jack worked as project manager, vice president and bridge division manager, and senior vice president for Johnson Brothers Corporation in Litchfield, responsible for leading bridge construction, rehabilitation and removal; earthwork for highways, site development, sewer and water lines, and treatment plants; substructures for power plants, steel mills and material handling facilities; dam rehabilitation; pile driving; construction of wharves, floodwalls and sector gates; and canal lining. HNTB has worked successfully with Jack on multiple projects over the past several years including the Hell Canyon Bridge and the tunnel projects at the MSP International Airport.

Hell Canyon Bridge, Custer, SD

Jack served a construction estimator and the constructability reviewer for this bridge type study, preliminary and final design of a 2,000-foot-long deck truss bridge within the Black Hills of South Dakota. This bridge was designed by HNTB.

I-35W Bridge over Mississippi River, Bridge 9340

Served as construction project manager for Industrial Construction Company. In that capacity, he was responsible for the substructure and construction of the superstructure for this bridge, including the steel erection of deck truss, deck placement and painting.

I-90 Bridge over Mississippi River, Dresbach, MN

Jack served as project manager on the construction of this new bridge consisting of plate girder spans.

US Hwy 63 over Mississippi River, Red Wing, MN

As project manager, Jack was responsible for the construction of this new bridge over the Mississippi River. The bridge is a through three-span truss with girder approaches.

Minnesota Approach to the Blattnick Bridge over St. Louis Bay, Duluth, MN

As manager of general construction, Jack supervised the construction of the superstructure for the Blattnick Bridge.

I-494 Bridge over Mississippi River, South St. Paul, MN

Jack participated in the construction of this new bridge, which included steel approach girders and a tied arch main span.

I-35W Bridge over Minnesota River, Bloomington, MN

Jack served as project manager for the construction of this plate girder span bridge over the Mississippi River.

Hennepin Avenue Suspension Bridge over Mississippi River, Minneapolis, MN

As manager of structures, Jack was responsible for the construction of this unique bridge in downtown Minneapolis. The Hennepin Avenue bridge is the only suspension bridge built in recent times in Minnesota and was design by HNTB. Jack designed the erection system for the suspension cables. The project included removal of the existing bridge.

ROBERT J. DEXTER, PHD, PE

Firm

University of Minnesota

Education

PhD, Civil Engineering, The University of Texas at Austin, Dissertation Title: "Investigation of Criteria for Ductile Fracture under Fully-Plastic Conditions", Advisor: Karl H. Frank.

MS, Civil Engineering, The University of Texas at Austin, Thesis Title: "Underwater Wet Welds: Mechanical Properties and Design Guidelines", Advisor: Karl H. Frank.

BS, Civil Engineering, The University of Texas at Austin, with Highest Honors

Registrations

Professional Engineer: Minnesota, Missouri, Pennsylvania, Idaho

Years of Experience

21

Research Interests

Fatigue and fracture of structures
Design, fabrication, and behavior of bolted and welded connections
Repair of damaged and deteriorated structures

Professional Activities

American Society of Civil Engineers (ASCE), Committee on Fatigue and Fracture
Transportation Research Board (TRB), Fabrication Committee, Steel Bridge Committee, General Structures
American Institute of Steel Construction (AISC), Task Committee 6, Connections

Experience

University of Minnesota, Associate Professor, Department of Civil Engineering, 1997-present

Experimentation and development of predictive models for the behavior and durability of structural components; primarily bolted and welded steel connections. Fatigue and fracture of steel structures and the associated problems of random dynamic loading from wind, truck traffic, etc. for seismic-load resisting frames, ships, bridges, bridge expansion joints and highway sign, signal, and light support structures. Developed specifications for testing, design, fabrication, and installation of modular bridge expansion joints that were adopted by the American Association of State Highway and Transportation Officials (AASHTO). Conducting research on various repair and retrofit methods for cracks in various types of structures, including development of a manual for repair of fatigue cracks in bridges for the Federal Highway Administration (FHWA).

Recent Publications

Corwin, E. and R.J. Dexter, (2002). "Analysis of Multi-beam Steel Bridges for Fatigue", *Structural Engineering International*, Vol. 12, No. 4, pp. 249-254.
O'Connell, H.M. and R.J. Dexter (2001). "Response and Analysis of Steel Trusses for Fatigue Truck Loading", *Journal of Bridge Engineering*, Vol. 6, No. 6, Nov/Dec, pp. 628-638.
Dexter, R.J. and J.W. Fisher (1999). "Fatigue and Fracture", Chapter 53, *Handbook of Bridge Engineering*, W.F. Chen ed., CRC Press Inc.
Dexter, R.J. and J.W. Fisher (1997). "Fatigue and Fracture", Section 20, The Structural Engineering Handbook, W.F. Chen, ed., CRC Press Inc. *(80%)*

STANLEY T. ROLFE, PHD, PE

Firm

University of Kansas

Education

PhD, Civil Engineering with Structural Major, University of Illinois
MS, Civil Engineering with Structural Major, University of Illinois
BS, Civil Engineering, University of Illinois

Registrations

Professional Engineer: Minnesota, Missouri, Pennsylvania, Idaho, Kansas

Years of Experience

40

Honors

ASTM Fracture Mechanics Medal
Shared ASCE State-of-the-Art of Civil Engineering Award as a Member of Committee on Fatigue and Fracture Reliability

Professional Activities

Chairman, AASHTO Technical Committee T-14, Weathering Steel Study Group
American Society of Civil Engineers Technical Committee on Fracture and Structural Fatigue
Member, American Society of Testing and Materials Committee E-08 on Fracture Testing of Metals

Experience

Interim Chair, Civil, Environental and Architectural Engineering, Albert P. Learned Professor, Department of Civil, Environmental and Architectural Engineering

Dr. Rolfe has been involved in a comprehensive experimental and analytical research program in fracture mechanics at the University of Kansas for 33 years. Prior to that time, he was Division Chief of the Material Behavior Division at U.S. Steel's Applied Research Laboratory in Monroeville, Pa. He has an extensive research background and considerable practical experience in the application of fracture mechanics to various fracture and fatigue problems. His research for the Pressure Vessel Research Committee and the American Iron and Steel Institute has focused on elastic-plastic fracture mechanics test development as well as fatigue and fracture control in steel structures. He has published extensively in the fields of fracture control, test development, correlations, CTOD test development, and applications of fracture mechanics.

He has written a textbook on *Fracture and Fatigue Control in Structures* co-authored by John Barsom of U.S. Steel. The Third Edition was published in 1999. He has consulted widely on structural failures in the field of fatigue and fracture control in structures. He has worked on a special assignment for the U.S. Coast Guard on Fracture Mechanics Methodology for Fracture Control in Oil Tankers and also for ORNL regarding fracture issues, particularly regarding the effect of shallow cracks.

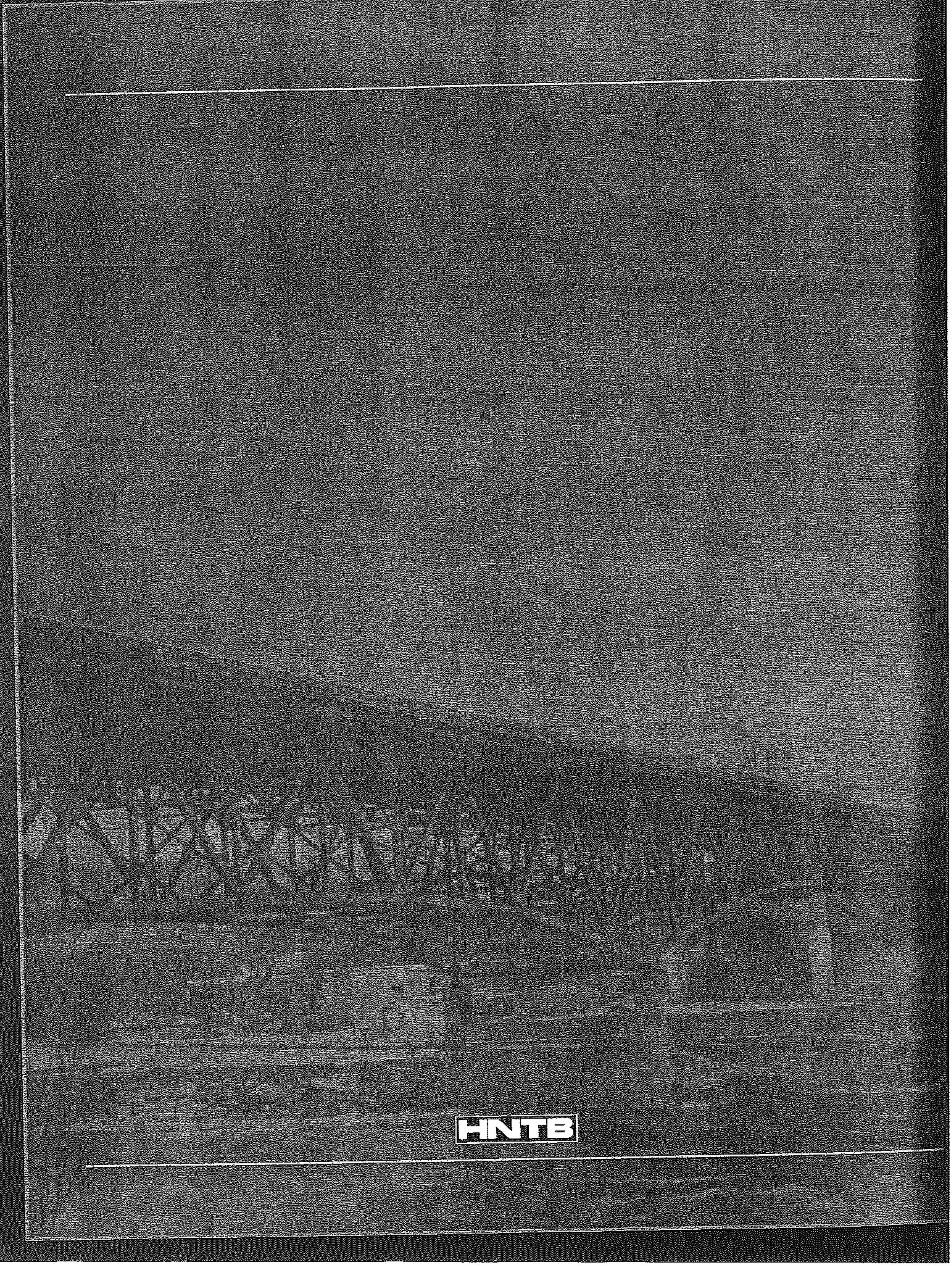
Recent Publications

Barsom, J. M. and Rolfe, S. T. "Fracture and Fatigue Control in Structures - Applications of Fracture Mechanics, Third Edition, ASTM, 1999.

Rolfe, S., "Fracture Mechanics Testing for Structural Steels," *Cement, Concrete, and Aggregates*, CCAGDP, Vol. 19, No. 2, Dec. 1997, pp. 92-102.

W. H. Munse and S. T. Rolfe, "Fatigue, Brittle Fracture, and Lamellar Tearing," Chapter in *Structural Engineering Handbook*, McGraw-Hill, 1997.

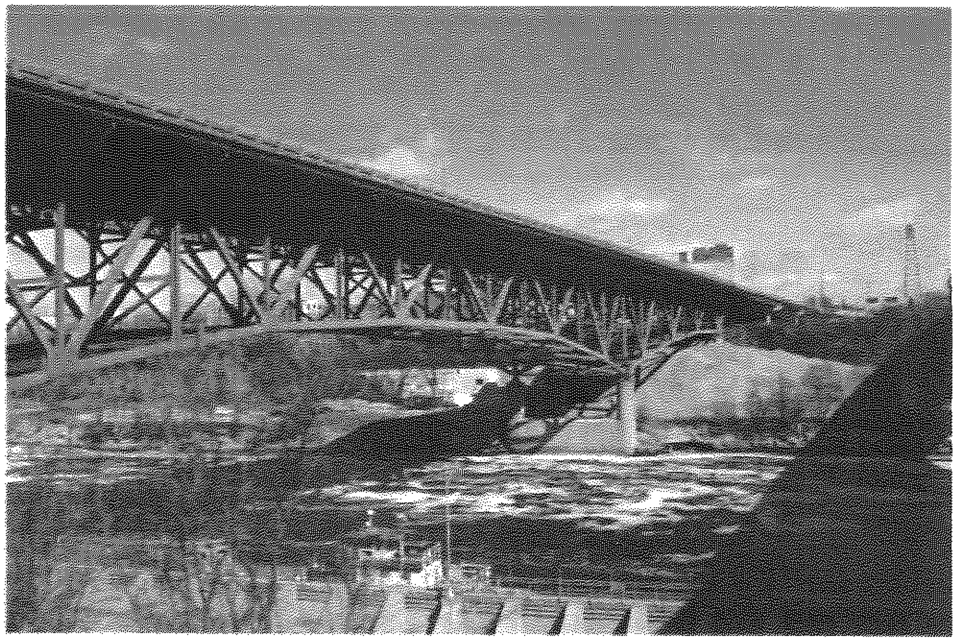
J. M. Barsom and S. T. Rolfe, "Fracture Mechanics in Failure Analysis," ASTM *STP 945*, 1988.



HNTB

Response of Interest for:

Fatigue Evaluation
Bridge 9340
35W Over Mississippi River



Prepared for:

Mn/DOT

Prepared by:

URS

Thresher Square
700 Third Street South
Minneapolis, MN 55414-1199

March 28, 2003

URS

March 28, 2003

Mr. Robert J. Miller
Bridge Agreements Engineer
Minnesota Department of Transportation
Offices of Bridges and Structures
3485 Hadley Ave. North
Oakdale, MN 55128-3307

RE: Request for Interest (RFI)
Fatigue Evaluation for Bridge 9340: TH 35W over Mississippi River

Dear Mr. Miller:

We are pleased to respond to this Request for Interest in preparing a scope of work for the TH 35 W Bridge Fatigue Evaluation Project. URS has an exceptionally well qualified team that is experienced on similar projects, understands the history of the bridge, and is able to deliver a quality engineering study to the Minnesota Department of Transportation.

This response of interest has been prepared to specifically address the following items as requested in your RFI:

- Project Objectives
- Project Approach/Work Plan
- Project Staff
- Project Deliverables/Timeline
- Relevant Projects

The TH 35W bridge presents a unique opportunity for URS and the Department to evaluate the fatigue and fracture characteristics of this structure and develop necessary retrofit and repair measures to best serve the public. As an older steel bridge with non-redundant main spans, fatigue problems and bridge deck deterioration, it requires experienced engineering judgement to evaluate fracture critical bridge members and to develop retrofit and repair measures. Our URS team will provide Mn/DOT with the experience and expertise needed to complete this project in a professional, timely, and cost-effective manner that exceeds expectations.

Thank you for the opportunity to respond to this RFI and we look forward to working with you on this project.

Sincerely,
URS Corporation

Donald J. Flemming

Donald J. Flemming, PE
Project Manager

Thresher Square
700 Third Street South
Minneapolis, MN 55415-1199
612.370.0700 Tel
612.370.1378 Fax

PROJECT OBJECTIVES

The following is our understanding of the primary project objectives for a fatigue/fracture evaluation of the deck truss-arch spans of Bridge 9340, as outlined in the Mn/DOT RFI:

1. Identify critical superstructure members that are most susceptible to fatigue/fracture failures. Evaluate their fatigue strengths, or remaining fatigue lives, under the cyclic stresses due to service loads.
2. Evaluate structural consequences for the loss of any one of the critical members (redundancy analyses)
3. Determine the necessity for repairs and establish most suitable repair methods and details as needed
4. Develop preferred schemes of deck replacement to minimize member stresses

PROJECT APPROACH/WORK PLAN

Data Collection: URS will begin the project with assembling all necessary information and materials from the Mn/DOT Records Center and Bridge Office files. The information to be collected will include, but not limited to, bridge plans, piling reports, shop drawings, material records, traffic history, inspection reports, as well as the study reports and strain measurement records of the University of Minnesota.

Cooperation with the University of Minnesota: URS will use the results of field strain measurements of the University of Minnesota in calibrating the computer model and in determining the stress range histogram in certain truss members. If we determine the needs for additional processing of existing data or additional field instrumentation as the project develops, we will discuss different options with Mn/DOT regarding whether URS or the University would provide any additional work. We will willingly cooperate with the University in all aspects of the project as directed by Mn/DOT.

Development of a 3-D Computer Model: URS has extensive experience in 3-D finite element analyses of complex bridge structures, including trusses and arches. We will develop a 3-D space frame model of the bridge including all structural steel members and the concrete deck. All truss/bracing members will be rigidly connected at the joints to resemble the reality and to be able to evaluate the effects of secondary bending. Bridge piers will also be included in the model for the effects of their stiffness to bridge responses under live and temperature loads. The composite actions between various superstructure elements, e.g. the deck, stringers, floorbeams and trusses, will be properly simulated. Connections at the end expansion joints to the approach spans will also be considered in the model. Support conditions of the superstructure at expansion bearings will have the capabilities of being adjusted for simulating an ideal expansion bearing (a roller), a frozen expansion bearing (a pin or a rigid connection), or a partial expansion bearing (a linear or nonlinear spring) based on field-determined stiffness.

Condition Assessment of Bridge Bearings, Joints and Piers through Field Measurements: URS will perform necessary measurements to assess the actual performances of all bridge bearings and the expansion joints to the approach spans for evaluating their impact to truss member forces. We will measure bridge movements at the bearings/joints, as well as the movement of the piers, with temperature changes and/or under the live load. These measurements will provide basis for setting proper support/restraint conditions of the computer model under thermal and live loads. Although frozen expansion bearings bring a benefit of reducing live load forces in certain truss members due to the frame/arch effect, adverse tensile forces are induced in truss members during temperature drops. This may potentially raise the risk of fracture in combination with lowered material toughness in cold temperatures. URS engineers are highly experienced in measuring structural strains and displacements using various instruments. We will discuss different options and finalize an effective instrumentation plan with Mn/DOT. Measurements of bearing movement and rotation and pier top movement with temperature changes, daily and/or seasonally, can be made with commercially available high-precision laser survey equipment with carefully selected/installed stationary targets as references. Bearing/pier rotation may also be directly measured with an inclinometer. Relative movements between the bridge superstructure and the top of piers as well as at end expansion joints can be measured with displacement transducers. Our experience indicates that the restraint/stiffness of old expansion bearings may be highly non-linear and highly variable. Conditions of expansion bearings can also be assessed in a short test by using strain gages under the live load. Readings of average axial strain from truss members framed into the joint at a bearing can be used to determine whether equilibrium of force is maintained in the longitudinal direction. Any unbalance of the longitudinal force components at the joint represents the restraint from the bearing.

Calibration of the Computer Model: Using the bridge bearing/joint/pier measurements and available strain measurement results from the University of Minnesota, URS engineers will calibrate and adjust our computer model for boundary conditions, including the stiffness of expansion bearings, piers and expansion joints to the approach spans. After the calibration, the model should be able to generate member forces and support movements in reasonable agreement with the measurement results.

Strength Evaluation/Ratings of Superstructure Members: After the calibration, we will use the computer model to perform structural analysis for dead, live and thermal loads. Critical loading combinations will be determined in accordance with the AASHTO load groups. The live load will be based on up to five vehicles identified by Mn/DOT, Strength ratings for the five vehicles will be performed per AASHTO Manual for Condition Evaluation of Bridges, 2nd Edition, 2000, with interim revisions through 2003. For the effects of temperature and live loads, two extreme support conditions will be considered for expansion bearings (i.e., rollers and rigid connections) and the strength rating of each member will be governed by the condition that results in a higher force.

Identification and Tabulation of Tension Members with Fatigue Details and Loading Stresses: URS will first identify tension truss members that are potentially subject to fatigue/fracture failures. Truss members that remain in compression throughout their service life can be omitted for fatigue/fracture evaluation. A review of available information has indicated that most truss members of Bridge 9340 are welded built-up box sections while some diagonals and verticals are welded H-sections. The connections are both riveted and bolted. The truss members have numerous poor welded details, including intermittent fillet welds, welded longitudinal stiffeners and welded attachments at diaphragms inside tension members. These details are classified as Categories D and E per current AASHTO fatigue provisions. Steel corrosion and pack rusting have also been noted in recent inspections. Upon completion of data collection and review, URS will tabulate all identified tension truss members with descriptions of existing fatigue susceptible details, their AASHTO fatigue categories, and loading stresses (axial stresses due to dead load, live load, temperature load if any, respectively, and their combinations). The most critical fatigue/fracture members will be identified with the consideration of both the live load stress range for fatigue and the total tensile stress for fracture.

Identification of Fracture Critical Members and Design of Contingency Repairs: URS is highly experienced in redundancy analysis of steel truss bridges, for both new designs and existing structure evaluation. We will use the calibrated computer model to identify fracture critical members in the superstructure. Under the dead and live loads, each tension truss member will be removed from the model and a stiffness analysis will be made. Under the influence of load redistribution, all remaining members will be checked for possible tension or compression failure. If one or more member(s) is overstressed to failure, the failed member(s) will be removed from the model in addition to the member initially removed. After a stiffness analysis in this condition, if any additional member failure is possible or the structure is statically unstable, then the initially removed member is identified as a fracture critical member. This procedure will be repeated for all tension members. The effect of temperature changes and dysfunctional bearings will also be considered in the analysis, with attention paid to the impact of a sudden release of partially frozen expansion bearings. The criteria for member failure will include the member sections as well as connections/joints. We will consider all possible failure modes, including compression failures due to buckling/yielding and tension failures due to fatigue/fracture/yielding. URS will identify at least eight fracture critical members that contain critical fatigue susceptible details and design contingency repairs for each member to be utilized by Mn/DOT if/when cracking is discovered. The repair schemes will improve the structural redundancy by adding load-carrying elements to the member (e.g. plates, tendons, etc.) and/or by altering global load paths in the superstructure (e.g. making various superstructure elements into composite systems, etc.).

Assessment of Remaining Fatigue Life: Based on the cyclic stresses determined from the computer model and the University of Minnesota's field strain measurements, URS will evaluate the fatigue strength and remaining fatigue life of all identified tension members. The effects of secondary bending in truss members and section loss due to corrosion will also be considered depending on the type of fatigue detail and its location with respect to the member. For each fatigue detail on the bridge, we will select the most suitable fatigue strength, or the S-N curve with a constant amplitude fatigue limit, based on the most recent research results. We will also determine the most suitable yet safe method for calculating the effective stress range from the measured stress range histogram as well as the correlation between the histogram and the traffic count. We will then perform the fatigue evaluation and present the results in terms of the remaining life for each tension member, with a quantified factor of safety based on the actual fatigue strength (S-N curve) of the detail. Additionally, we will assess the fatigue strength, or remaining fatigue life, in accordance with the AASHTO specifications. In our opinion, the following three AASHTO specifications are most applicable to this project: (1) *Guide Specifications for Fatigue Evaluation of Existing Steel Bridges*, 1990, with interim revisions through 1995; (2) *LRFD Bridge Design Specifications*, 2nd Edition, 1998, with interim revisions through 2003; and (3) *Manual for Condition Evaluation and Load Resistance Factor Rating of Highway Bridges* (LRFR), to be issued in spring 2003. The Fatigue Guide Specifications and the LRFR Manual have provisions for using field strain measurements as an alternative method for determining live load stress ranges. URS will summarize our findings of the fatigue evaluation following the requirements of each of these AASHTO specifications as well as the probability of fatigue cracking based on the actual S-N curve.

Development of Redecking Schemes for Minimizing Member Stresses: URS has extensive experience designing bridge deck replacement projects that satisfy various needs, such as reducing critical member stresses and maintaining traffic capacity during construction. We will develop at least four staging and sequencing alternatives for deck removal and replacement over the truss spans. Our schemes will satisfy the traffic needs as specified by Mn/DOT. Key issues include: (1) the potential for significant unsymmetrical loadings to the truss spans; (2) the extent of slab removal prior to placement of the new deck; (3) weight difference between the current deck and the new deck; and (4) the position and weight of temporary traffic barriers and loadings from construction equipment.

We will develop conceptual replacement decks based on cast-in-place and precast, post-tensioned construction methods and we will evaluate use of lightweight concrete to reduce the deck's weight and increase the truss's live load capacity. Composite construction, replacement or modification of stringers, and elimination of intermediate deck joints will be assessed for potential improvement of critical member redundancy and for stiffening the global behavior of the truss spans. A new deck incorporating stiffening girders detailed to furnish composite behavior with the truss could prove to be an effective method for substantially lowering maximum stresses and stress ranges by altering the truss structure's basic response to loading. This approach could also form reliable alternative load paths for many critical truss members. We will utilize the 3-D computer model to determine the stresses and ranges of stress imposed on the structure during each redecking alternative. The alternatives will then be further refined to keep truss member stresses during construction within acceptable levels. Advantages and disadvantages and comparative estimated costs for each deck replacement alternative will also be assessed.

Final Report: URS will prepare a final report for submission to Mn/DOT. The report will summarize our procedure, results and findings of all the project tasks described above. In the report we will present our recommendations on the necessity and methods of repairs to address bridge bearings, fatigue susceptible details, and fracture critical members. We will also recommend preferred schemes of deck replacement for minimizing member stresses.

PROJECT TEAM/MANAGEMENT

Project Key Staff: The URS project key staff members are identified as follows:

- Donald J. Flemming, PE – Project Manager
- Y. Edward Zhou, PhD, PE – Project Engineer
- David D. Long, PE – Assistant Project Engineer
- Thomas D. Jenkins, PE – Quality Assurance and Quality Control Officer

These key staff members will be available throughout the project and their resumes are attached. Mr. Flemming has over 40 years of bridge engineering/management experience and is highly familiar with the requirements, policies and procedures of Mn/DOT. He will be responsible for managing the URS project team and coordinating with the Mn/DOT. Dr. Zhou specializes and has extensive experience in fatigue evaluation of steel bridges. He will lead the engineering efforts in structural analyses, field measurements and fatigue/fracture evaluation and will be the primary writer of the final report. He has performed fatigue/fracture evaluation and retrofit design of several steel truss bridges which are very similar to Bridge 9340. Dr. Zhou was just elected as chairman of the ASCE committee on fatigue and fracture and also teaches graduate course "Fatigue and Fracture in Steel Bridges" at Johns Hopkins University as an adjunct professor. Mr. Long is experienced in structural analysis, design and inspection of various bridge types and will assist Dr. Zhou in executing the project tasks. Mr. Jenkins is the chief bridge engineer and has extensive experience in bridge design, evaluation and rehabilitation of all structural types. He has been the lead designer of several bridge projects that won national awards for excellence and innovation in design and/or deck replacement. Being one of the largest engineering consultants, URS is able to provide highly qualified engineers for completing all tasks in time under the directions of the key staff.

Communication/Coordination with Mn/DOT: Mr. Flemming, the URS Project Manager, will serve as the primary liaison between Mn/DOT and the URS project team. Mr. Flemming, assisted by Dr. Zhou as needed, will maintain proper and necessary communications with Mr. Paul Kivisto, the Project Manager of Mn/DOT Office of Bridges and Structures. Mr. Flemming will report project progress to Mr. Kivisto on a regular basis. URS will also inform Mn/DOT for any new findings or unexpected issues as the project develops in a timely manner.

Quality Assurance/Quality Control (QA/QC): URS is committed to providing quality and timely service to Mn/DOT. To ensure that this commitment is achieved, we have established a QA/QC program. The Project Manager and the Project Engineer will develop a detailed work plan for each assignment, including a detailed scope of work and schedule. This work plan will be distributed to all staff working on the assignment. Detailed checking will be performed for all analysis, design, and contract documents. The final documents/report will go through a thorough independent technical review by Mr. Jenkins, the URS QA/QC officer, before submittal to Mn/DOT.

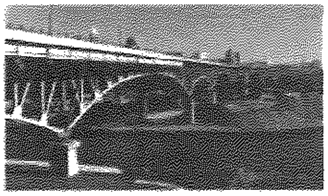
PROJECT DELIVERABLES AND TIMELINE

It is assumed that an agreement will be executed and work will start in May 2003. URS will deliver three copies of the final report and one copy of the structural assessment calculations to Mn/DOT within 16 months of contract execution. We will attend all interim project status meetings and submit all interim reports as required by Mn/DOT.

RECENT RELEVANT PROJECTS

Three recent URS projects relevant to the fatigue/fracture evaluation of Mn/DOT Bridge 9340 are shown below:

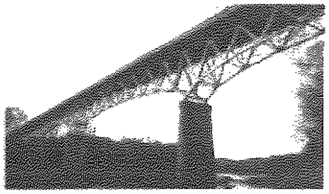
Cleveland Central Viaduct (I-90 over Cuyahoga River), Cleveland, Ohio



Client/Year: Ohio Department of Transportation/2001
Bridge Type: Deck Trusses with Welded Steel Girder Approaches
URS Scope: Strength Ratings, Fatigue Evaluation and Repair Recommendations

Constructed in 1959, the 8-lane, riveted steel structure consists of nine-span continuous cantilevered deck trusses flanked by continuous span girder approaches. URS performed in-depth structural analyses using several space frame computer models to identify critical members for strength and fatigue. All members were tabulated for AASHTO strength ratings and tension members identified for fatigue assessment after critical fatigue details were identified. An analytical fatigue evaluation using the fatigue truck following the procedure in *AASHTO Guide Specifications for Fatigue Evaluation of Existing Steel Bridges* indicated insufficient fatigue strength for the continuing service. Consequently, URS performed field measurements of strains in identified fatigue-critical members under controlled test vehicle and normal traffic. Secondary stresses in truss members due to joint fixity and laterally framed members, as well as stress increases at corroded sections were also evaluated in the test program. Based on the stress range histograms measured over a two-week period, URS determined the effective stress ranges for the critical members. In accordance with applicable provisions in the AASHTO Fatigue Guide Specifications, URS determined the remaining fatigue life of the structure and made recommendations for repairs.

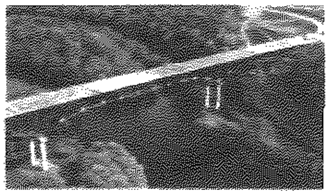
US Route 522 over Potomac River, Hancock, Maryland



Client/Year: Maryland State Highway Administration/2002
Bridge Type: Wichert Deck Trusses and Wichert Girders
URS Scope: Fatigue Evaluation and Retrofit Design

The 2,577-ft long steel structure consists of continuous Wichert truss spans and continuous Wichert girder spans. Constructed in 1939, the steel superstructure is made of riveted built-up members, riveted and bolted connections, as well as some welds. The structure has a history of fatigue problems with cracks in the gusset plate around the top pin of rhomboids, stringer-to-floorbeam connections, and most recently, in the web of floorbeams between the stringer connection plate and the bottom flange. URS conducted an emergency field inspection after long fatigue cracks were found in a steel floorbeam and directed on-site hole-drilling for crack arrest. Subsequently, URS performed in-depth structural analyses with a space frame computer model to assess stress variations in the critical fatigue details due to live load. It was concluded that the fatigue problems were primarily caused by the unintended composite action between the floor system and the main trusses/girders in combination with the low stiffness of many connections. The general retrofit scheme was to strengthen the connection for longitudinal shear between the floor system and the main trusses/girders and to strengthen the connections between the stringers and the floorbeams. URS developed contract drawings and part of the retrofit construction was completed in 2002.

Route 33 over Lehigh River, Easton, Pennsylvania



Client/Year: Pennsylvania Department of Transportation/2002
Bridge Type: Steel Deck Trusses
URS Scope: Preliminary and Final Designs with Redundancy Analysis

URS performed preliminary and final designs of the four-span continuous steel deck truss bridge with a main span of 594 ft. Structural redundancy was given special consideration for this two-truss system. A 3-D space frame model was developed to determine structural consequences when each tension member was removed individually under the dead and live loads. Member design forces under these circumstances were determined and critical members for maintaining structural integrity under redistributed loads were identified. The design maximized structural redundancy by taking some special measures. The top chord was made composite with the deck to obtain the redundancy. The deck reinforcement was increased and mechanically spliced to provide required tension capacity. The stringers and floorbeams were made composite to the deck to increase the integrity of the floor system. Internal redundancy was provided for fracture critical bottom chord members by adding steel plates on each side of the welded H-section. The elements were designed for extreme event loading assuming any one of the three elements failed. These special considerations significantly increased the redundancy of the structure.

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Donald J. Flemming, PE
Senior Bridge Engineer

Experience

Donald Flemming is a Senior Bridge Engineer in URS' Minneapolis office. His responsibilities include coordination of bridge engineering projects for Central Region One. He has 42 years' transportation and bridge engineering experience including 14 years as State Bridge Engineer for the Minnesota Department of Transportation (Mn/DOT).

Bridge Design and Rehabilitation

Major bridge projects which Mr. Flemming has been involved with include:

- I 35w Bridge over the Mississippi River repairs and rehabilitation, Minneapolis, MN
- High Bridge over the Mississippi River, St. Paul, MN
- Lake Street Bridge over the Mississippi River between St. Paul and Minneapolis, MN
- I-94 Dartmouth Avenue Bridge over the Mississippi River between St. Paul and Minneapolis, MN
- Blatnik Bridge rehabilitation over the Duluth harbor, Duluth, MN
- I-90 Dresbach Bridge over the Mississippi River, Dresbach, MN
- North Star Bridge over the Minnesota River, Mankato, MN
- Mendota Bridge rehabilitation over the Minnesota River in Mendota, MN
- Bong Bridge over the Duluth harbor, Duluth, MN

Education

Bachelor of Science in Civil Engineering, University of Minnesota, 1961

Professional Registrations/ Affiliations

Registered Professional Engineer – Minnesota and North Dakota
American Society of Civil Engineers
National Society of Professional Engineer
Minnesota Surveyors and Engineers Society
TRB Steel Bridge Committee
TRB Steel Fabrication Committee
TRB General Structures Committee
TRB Concrete Committee

Work History

URS Corporation, Director of Bridge Engineering (2001 to Present)
Mn/DOT: State Bridge Engineer (1986 to 2000)
Various Bridge Engineering Positions (1961 to 1986)

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Y. Edward Zhou, PhD, PE
Structural Engineer

Experience Summary

Dr. Zhou has 17 years, including 9 years with URS, he has extensive experience in bridge evaluation through combined finite element analysis and field strain/displacement measurement. He has exceptional expertise in fatigue/fracture analysis of steel bridges. His experience also includes analysis, design, inspection, evaluation and repairs of all types of bridges.

Key Projects

Cleveland Central Viaduct (I-90 over Cuyahoga River), Ohio. Performed space frame structural analysis for strength ratings and fatigue/fracture evaluation of the 50-year old 9-span continuous riveted steel deck truss bridge. Conducted field strain measurements in critical members for stress range histograms under normal traffic. Determined remaining fatigue life of the structure and made repair recommendations.

US Route 522 Bridge over Potomac River, Hancock, Maryland. Conducted emergency inspection after long fatigue cracks were found and directed on-site hole-drilling for crack arrest. Performed fatigue evaluation of the 60-year old steel bridge consisting of continuous Wichert deck truss and Wichert girder spans. Performed space frame structural analysis and designed retrofit for correcting various fatigue problems.

Millard E. Tydings Memorial Bridge (I-95 over Susquehanna River), Maryland. Performed fatigue investigation for various cracks observed in the welded steel floor system of the 11-span cantilevered deck truss bridge built in early 1960's. Designed repairs, bearing replacement at expansion joints above hangers, temporary support system and jacking for fatigue retrofit.

Great Bridge, Chesapeake, Virginia. Performed 3-D finite element analysis of the highly skewed 250-ft span steel truss double-leaf rolling lift bridge with unsymmetrical live load bents. The model included all truss members, portal frame members, lateral braces, segmental girders, and a floor system made of floorbeams, stringers and orthotropical concrete-filled steel grid deck. It produced design forces for all members/connections under dead load at various open positions and live load at the closed position.

Education

BS / 1982 / Civil Engineering / Northern Jiaotong University, China
MS / 1990 / Civil Engineering / Lehigh University
PhD / 1994 / Structural Engineering / Lehigh University

Professional Registrations/ Affiliations

1995 / Professional Engineer / Maryland, No. 21330
1995 / Professional Engineer / Delaware, No. 10086
1999 / Professional Engineer / Virginia, No. 0402 033413
Chairman-Elect of ASCE Committee on Fatigue and Fracture
Member of ASCE Committee on Monitoring Structural Performance
Adjunct Professor of Johns Hopkins University

David D. Long, PE
Senior Structural Engineer

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Experience

Mr. Long is a Senior Structural Engineer in URS' Minneapolis office. He is experienced in bridge design, inspection and evaluation studies.

Bridge Design and Studies

Mr. Long has experience in preliminary and final design for a variety of bridge projects including highway, railroad and pedestrian bridges. He has experience in bridge studies, evaluations, inspections, rehabilitation, bridge ratings and has used various modeling techniques including three dimensional space frame modeling. He has experience in the following bridge types: curved and straight welded steel plate girders, pin and hanger welded steel plate girders, rolled steel beam, thru-girder steel railroad bridges, timber trestle railroad bridge, concrete flat slab, and prestressed concrete girder. He has experience with complex bridge layouts requiring high degrees of curvature, sharply skewed substructures and/or kinked girder geometry. Some of these projects include:

- Penn Avenue Bridge No. 27V45. Penn Avenue C.S.A.H. 32 over I-494 (Four Span Single Point Diamond Bridge) in Richfield. Highly complex steel framed bridge with high degrees of curvature and a sharply skewed Superstructure.
- Annual bridge inspections for the Cities of Coon Rapids and Arden Hills.
- Anoka County bridge inspection and repair (involved inspection of two existing prestressed concrete beam bridges and preparation of repair plans and special provisions) in Coon Rapids, MN
- Dartmouth Bridge (bridge inspection, superstructure replacement and widening of a 1000' steel plate girder bridge, I94 over Mississippi River) in Minneapolis, MN
- I-535 Blatnik Bridge (bridge inspection, rehabilitation and widening of an 8000' bridge) conecting Duluth, Mn to Superior, WI.

Education

Bachelor of Science in Civil Engineering, University of Minnesota, 1990

Professional Registrations/ Affiliations

Professional Engineer in the State of Minnesota (24384/1996)
Minnesota Concrete Council (MCC)
American Concrete Institute (ACI)

Work History

URS Corporation Senior Structural Engineer (1998 to Present)
RCM Associates Inc., Structural Project Engineer (1995 to 1998)
Parsons Brinkerhoff Quade & Douglas, Inc., Structural Engineer (1990 to 1995)
Bladholm Bros. Prestress, Structural Engineer (1990 to 1990)

URS

Thomas D. Jenkins, PE
Chief Bridge Engineer

Experience Summary

Mr. Jenkins has 30 years experience, all with URS. He currently serves as Vice President and Chief Bridge Engineer responsible for structural design and direction of bridge projects. His expertise is in bridge analysis and design in structural steel, reinforced concrete, and prestressed concrete, including long-span steel truss bridges. He has extensive experience in evaluation of and retrofit design for existing structures exhibiting distress.

Key Projects

Cleveland Central Viaduct Bridge (I-90 over Cuyahoga River), Ohio. Load rating analysis, fatigue evaluation, strain gauge testing, and rehabilitation and widening studies for a nine-span continuous steel cantilever deck truss (2,720 feet long).

US Route 522 Bridge over Potomac River, Hancock, Maryland. Fatigue evaluation of steel bridge consisting of continuous Wichert deck truss and Wichert girder spans including space frame structural analysis and preparation of retrofit plans for correcting fatigue-related cracking.

Lehigh River Bridge, Easton, Pennsylvania. Preliminary and final design development for this 1,800-foot-long, four-span composite steel truss with a main river span length of 594 feet. Design included a complete structure three-dimensional analysis used for identification of non-redundant tension members which were then detailed to provide redundant elements.

Fracture Critical Bridges, Statewide, Michigan. Development of an inspection guide for the Michigan Department of Transportation's fracture critical bridges. Included evaluation of all welded and fatigue-sensitive details on the bridges.

Fracture Review for Hoan-Like Details, Maryland. Performed detail review and provided retrofit recommendations for steel girder fracture critical bridges potentially having tri-axial constraint at bracing connections similar to conditions responsible for brittle fracture of the Hoan Bridge.

I-95 over James River, Richmond, Virginia. Superstructure rehabilitation and replacement for two parallel 4,185-foot-long bridges over James River. Pre-constructed composite units were used for nighttime superstructure replacement. Precast filled grid deck panels were used for nighttime deck replacement.

Education

BS / 1972 / Civil Engineering / University of Virginia
ME / 1974 / Civil Engineering / University of Virginia

Professional Registrations/ Affiliations

1978 / Professional Engineer / Maryland, No. 11219
1979 / Structural Engineer / Illinois, No. 4261
1991 / Civil Engineer / California, No. C47439
1996 / Professional Engineer / Michigan, No. 41762

Mn/DOT Agreement No.85109

CFMS Contract No. A48811

STATE OF MINNESOTA
PROFESSIONAL AND TECHNICAL SERVICES CONTRACT

Project Identification: Bridge Inspection for Bridge No. 9340 (I-35W over Mississippi River)
State Project Number (SP): N.A. **Trunk Highway (TH):** 35W

This Contract is between the State of Minnesota acting through its Commissioner of Transportation (State) and URS, Inc. Address: Thresher Square, 700 Third Street South, Minneapolis, Minnesota 55415 (Contractor).

Recitals

1. Under Minnesota Statutes §15.061, the Commissioner of Transportation is empowered to engage such assistance as deemed necessary.
2. The State is in need of the Contractor's participation and assistance during the State's annual inspection of Bridge No. 9340 (I-35W over the Mississippi River). The Contractor's participation during annual inspections will allow a preliminary assessment of the bridge's structural condition. Under a future agreement, to be executed after completion of the scheduled inspections, the Contractor is to perform a structural evaluation of the bridge's fracture critical components.
3. The Contractor represents that it is duly qualified and agrees to perform all services described in this contract to the satisfaction of the State.

Contract Special Terms

Article 1 Term of Contract:

1.1	Effective date:	The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.
1.2	Work Completion date:	August 31, 2003
1.3	Expiration date:	December 31, 2003, or until all obligations have been approved, which ever occurs first.
1.4	Survival terms:	The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.
1.5	Exhibits:	Exhibits A through D are attached and incorporated into this Contract.

Article 2 Scope of Work:

2.1 The services to be provided for under this Contract by the Contractor are:
The Contractor will participate with the State's personnel during their annual inspection of Bridge No. 9340. This primarily includes accompanying the State's inspectors in a snooper basket to assess the existing structural condition of key superstructure components.

2.2 Deliverables are defined as the work product created or supplied by the Contractor pursuant to the terms of this Contract. The brief summary of the deliverables of this Contract are as follows:

Items	Date Due
Contact report summarizing the findings of the inspection. (2 copies – Heavy Bond Paper, including appropriate photos)	21 calendar days after completion of Annual Inspection

2.3 The State's Project Manager has the authority to update and adjust all project schedules when necessary at progress meetings within the terms of the Contract.

2.4 See Exhibit A for details on scope and deliverables.

Article 3 Items Provided and Completed by the State:

3.1 After authorizing the Contractor to begin work, the State will furnish any data or material in it's possession relating to the project that may be of use to the Contractor in performing the work.All such data furnished to the Contractor, will remain the property of the State and will be promptly returned upon the State's request or upon the expiration or termination of this contract.

3.2 The Contractor will analyze all such data furnished by the State. If the Contractor finds any such data to be incorrect or incomplete, the Contractor will bring the facts to the attention of the State before proceeding with the part of the project affected. The State will investigate the matter, and if it finds that such data is incorrect or incomplete, it will promptly determine a method for furnishing corrected data. Delay in furnishing data will not be considered justification for an adjustment in compensation.

3.3 See Exhibit A for a detailed listing of responsibilities to be completed or items to be provided by the State.

Article 4 Consideration of Payment:

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	$ 2,566.00
2. Overhead:	$ 3,342.47
3. Fixed Fee:	$ 709.02
4. Direct Expenses:	$ 202.40
Total Contract Amount:	$ 6,819.89

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B. Any other direct costs not listed in Exhibit B must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B for Budget Details on the Contractor.

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed $ 6,819.89.

Article 5 Terms of Payment:

5.1 The Contractor will use the format set forth in Exhibit C when submitting Invoices.

5.2 The Contractor will submit the monthly progress report set forth in Exhibit D showing the progress of work in work hours according to the tasks listed in Article 2 Scope of Work.

Article 6 Contractor's Authorized Agent and Project Team:

6.1 The Contractor's Authorized Agent will be:

Name: Donald J. Flemming, P.E.
Title: Project Manager

Address: Thresher Square
700 Third Street South
Minneapolis, Minnesota 55415
Phone: (612) 370-00700

If the Contractor's Authorized Agent or Project Manager changes at any time during this Contract, the Contractor will be responsible to follow conditions laid out within Article 16 of the General Terms.

Article 7 State's Authorized Agent and Project Manager:

7.1 The State's Authorized Agent will be:

Name: Robert J. Miller, P.E.
Title: Bridge Agreement Engineer
Address: 3485 Hadley Avenue North
Oakdale Minnesota 55128-3307
Phone: (651) 747-2105

The State's Authorized Agent, or his/her successor, has the responsibility to monitor the Contractor's performance and the authority to accept the services provided under this contract. If the services are satisfactory, the State's Authorized Agent will certify acceptance on each invoice submitted for payment.

7.2 The State's Project Manager for this Contract will be:

Name: Robert J. Miller, P.E.
Title: Bridge Agreement Engineer
Address: 3485 Hadley Avenue North
Oakdale Minnesota 55128-3307
Phone: (651) 747-2105

The State's Project Manager, or his/her successor, has the responsibility to monitor the Contractor's performance and progress, the Project Manager will sign progress reports, review billing statements, make recommendations to the State's Authorized Agent for acceptance of the Contractor's goods or services, and make recommendations to the State's Authorized Agent for certification for payment of each Invoice submitted for payment.

Article 8 Modification of the General Terms:

8.1 Delete Article 15.3 "Retainage" pursuant to Minnesota Statutes Sections 16C.08, subdivision 5, which states that retainage paragraph does not apply to contracts for professional services as defined in Minnesota Statutes Sections 326.02 to 326.15.

Article 9 Additional Provisions:

None

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General Terms

Article 10 **Term of Contract**

10.1 This Contract will be effective upon the date set in the Special Terms and will remain in effect until the Expiration Date set in the Special Terms, or until all obligations set forth in this Contract have been fulfilled to the satisfaction of State, or until terminated under Article 31, whichever event occurs first.

10.2 For delays encountered that are beyond Contractor's control, and upon written request from Contractor, State's Authorized Agent may extend the Work Completion Date, as set forth in the Special Terms of this Contract. The length of such time extension will be determined by State's Authorized Agent and will not exceed the Expiration Date of Contract.

10.3 It will be Contractor's responsibility to notify State's Project Manager and State's Authorized Agent, in writing, if the project will not be completed as scheduled. State's Project Manager will have the authority to adjust the schedule, in writing, within the term of Contract.

Article 11 **Governing Law, Jurisdiction, and Venue**

11.1 This Contract will be interpreted pursuant to Minnesota law. Any citation to federal or state law incorporates the language of that law into this Contract as if fully set forth herein. Venue for all legal proceedings arising out of this Contract, or its breach, will be in the applicable state or federal court with competent jurisdiction in Ramsey County, Minnesota.

Article 12 **Terms of General Terms**

12.1 Any and all provisions of these General Terms will remain in force unless they are specifically modified, in writing, by the Special Terms of this Contract.

12.2 To the extent of any inconsistencies between the Special Terms and these General Terms, the Special Terms will control. Minnesota law supersedes any of the Special Terms or General Terms set forth in this Contract.

Article 13 **Terms of Payment**

13.1 Subject to the provisions of the Special and General Terms, all services performed and/or goods satisfactorily supplied by Contractor pursuant to this Contract will be paid by State. Compensation will be in accordance with the Special Terms, Article 4 Consideration of Payment.

13.2 If it appears at any time that Contractor will exceed the Total Contract Amount stated in the Special Terms of this Contract, Contractor must notify State's Authorized Agent in writing in a timely manner. Contractor will not be compensated for work performed in excess of the Total Contract Amount without a written, and fully executed, amendment to this Contract. Any work performed beyond that which is provided for in this Contract without a prior written amendment signed by State, will be deemed voluntary and Contractor will not be entitled to compensation for the extra work.

13.3 If Contractor claims any instructions, latent conditions, or conditions exist that cause extra cost under this Contract, Contractor must make a written notice for any extra cost incurred within 10 days after such instruction or observance of conditions. Latent conditions are conditions not anticipated by the Special Terms of this Contract. Any claims made without a written notice will be refused and no claim will be valid unless so made. Any work performed under an amendment to this Contract that has not been properly approved and executed by the parties will be performed at Contractor's own risk. State's Authorized Agent will have the sole authority to determine whether any claimed extra costs are reasonable under the circumstances and whether State will approve the extra costs.

13.4 State will not pay overtime rates for any overtime work or services performed by Contractor or a subcontractor unless State's Authorized Agent has specifically requested Contractor to do so in writing. When specifically authorized by State's Authorized Agent, overtime premium pay will be reimbursed as a direct cost for the overtime portion of the hourly rate and is not eligible for overhead costs or profit.

13.5 Reimbursement for travel and subsistence expenses actually and necessarily incurred by Contractor as a result of performance of this Contract will not exceed the amount defined in the Special Terms. Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations." Contractor will not be reimbursed for travel and subsistence expenses incurred outside the state of Minnesota unless it has received prior written approval from State for such out of state travel. The state of Minnesota will be considered the home base for determining whether travel is "out of state."

13.6 The final payment due Contractor will be based on actual acceptable costs as determined by an audit conducted by State. The audit will be conducted using the Cost Principles and Procedures set forth in the Federal Acquisition Regulations, 48 Code of Federal Regulations Section 31, or as modified by state policies and procedures. Based upon final audit, the final payment to Contractor may exceed the Total Contract Amount without amending this Contract.

Article 14 Procedure for Payment

14.1 Payments will be made by State within 30 days of Contractor's presentation of invoices and progress reports for services performed and the acceptance of such services by State's Authorized Agent as identified in Minnesota Statutes Section 16A.124.

14.2 Invoices for payment must be submitted by Contractor monthly to State's Authorized Agent in the form prescribed by State. Invoices must identify the cost for the services performed and/or goods delivered for the billing period and must satisfy the requirements listed below:

14.21 Each invoice must contain the following information: Mn/DOT Agreement Number, Mn/DOT contract invoice number (sequentially numbered), billing address if different from business address, and Contractor's original signature attesting that the invoiced services and costs are new and that no previous charge for those services and/or goods has been included in any prior invoice.

14.22 Direct nonsalary costs allocable to the work under this Contract, and defined in the Special Terms of this Contract, must be itemized and supported with invoices or billing documents to show that such costs are properly allocable to the work. Direct nonsalary costs are any costs that are not the salaried costs directly related to the work of Contractor. Supporting documentation must be provided in a manner that corresponds to each direct cost.

14.23. The original of each invoice and progress report must be sent to State's Authorized Agent for review and payment.

14.24 Contractor must provide, upon request of State's Authorized Agent, the following supporting documentation:

a. Direct salary costs of employees' time directly chargeable for the services performed under this Contract. This must include a payroll cost breakdown identifying the name of the employee, classification, actual rate of pay, hours worked, and total payment for each invoice period; and

b. Signed time sheets or payroll cost breakdown for each employee listing dates and hours worked. Computer generated printouts of labor costs for the project must contain the project number, each employee's name, hourly rate, regular and overtime hours, and the dollar amount charged to the project for each pay period.

14.3 If Contractor is authorized by State to use or uses any subcontractors, Contractor must include all the above supporting documentation in any subcontractor's contract, and Contractor must make timely payments to its subcontractors.

14.4 Contractor must require subcontractors' invoices to follow the same form and contain the same information as set forth in this Article14.

Article 15 Conditions of Payment

15.1 All services and/or goods provided by Contractor pursuant to this Contract must be performed to the satisfaction of State, and in accordance with the following:

15.11 Applicable federal, state, and local laws, ordinances, rules, and regulations.
15.12 Applicable state standards, policies, and practices.

15.2 Contractor will not receive payment for work determined by State's Authorized Agent to be unsatisfactory, or performed in violation of federal, state, or local laws, ordinances, rules, or regulations.

15.3 Retainage: Pursuant to Minnesota Statutes Section 16C.08, subdivision 5(b), as enacted, no more than 90 percent of the compensation due under this Contract may be paid until the final product(s) of this Contract have been reviewed by the head of the Minnesota Department of Transportation ("Mn/DOT"). The balance due and owing will be paid at the time that the head of Mn/DOT determines that Contractor has satisfactorily fulfilled all the terms of this Contract.

15.4 All services and/or goods covered by progress payments made by State will become the sole property of State. This provision must not be construed as relieving Contractor from sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work or as waiving the right of State to require the fulfillment of all of the terms of this Contract.

15.5 Nothing in this Contract must be construed in any way to operate to relieve Contractor from its obligation to complete the services and/or deliver any goods described in this Contract for a sum not to exceed that set forth in the Special Terms.

Article 16 Contractor's Key Personnel

16.1 Contractor's key personnel specified by name and title in the Special Terms will be considered essential to the work being performed.

16.2 If, for any reason, substitution of a key person becomes necessary, Contractor must provide two weeks' advance written notification of the substitution to State's Authorized Agent. The written notification must include the proposed successor's name and a resume of his/her qualifications. State's Authorized Agent will have the right to reject the proposed successor based upon reasonable grounds.

Article 17 Assignment

17.1 Contractor may neither assign nor transfer any rights or obligations under this Contract without authorization from State's Authorized Agent and a fully executed assignment agreement. The written authority will in no way relieve Contractor from the primary responsibility for performance of the services and/or delivery of the goods specified in this Contract.

Article 18 Subcontracts

18.1 Contractor must require all subcontractor contracts to contain all appropriate terms and conditions of this Contract, including Articles 10, 11, 13, 14, 16, 18 through 34 and 36, as they apply to the sub contractor. The use of subcontractors does not relieve Contractor from performing and delivering the work stated in this Contract.

18.2 State's Authorized Agent must review, and accept for compliance with the General and Special Terms of this Contract, all subcontractor contracts exceeding $10,000.00 prior to the execution of any such subcontractor contract. State's Authorized Agent has the authority to reject any subcontractor contract that does not comply with the General and Special Terms of this Contract.

18.3 A copy of any and all subcontractor contracts must be sent to State's Authorized Agent after execution of the subcontractor contract and prior to work starting under the subcontractor contract.

Article 19 Amendments, Change Orders, Merger, and Waiver

19.1 Amendments to this Contract will be considered only for unforeseen work or services that were excluded in the Scope of Work of the Special Terms and that are considered essential to the work. Any written claim made by Contractor for extra work or costs under this Contract that has been approved by State's Authorized Agent must be evidenced by an amendment to this Contract. Amendments must be in writing and executed and approved by the same parties and officials who executed and approved the original Contract, or their successors in office. Contractor must notify State's Project Manager in writing if Contractor will be delayed in any way from completing the project under this Contract.

19.2 The work to be done in connection with this Contract may be changed at the request of State, with the mutual concurrence of Contractor. Any change will be clearly and fully defined in writing, and approved by both parties. Change orders must be consistent with the basic purpose of this Contract and within the general Scope of Work identified in the Special Terms. Changes in the Total Contract Amount or Contract Expiration Date are not permitted in a change order.

19.3 This Contract, including all incorporated items, contains all negotiations and agreements between Contractor and State. No other understanding, whether written or oral, regarding this Contract, may be used to bind either party.

19.4 Failure of a party to enforce any provision of this Contract will not constitute, or be construed as, a waiver of such provision or of the right to enforce such provision.

Article 20 Affirmative Action

20.1 For contracts in excess of $100,000.00, Contractor certifies that it is in compliance with Minnesota Statutes Section 363.073.

20.2 Contractor certifies that it is an equal opportunity employer and complies with Title VI of the Civil Rights Act of 1964, and the President's Executive Order Number 11246 as amended by Executive Order Number 11375. Accordingly, 49 Code of Federal Regulations Section 21 through Appendix C and 23 Code of Federal Regulations Section Part 200 will be applicable.

20.3 If Contractor has more than 40 full-time employees within the State of Minnesota on a single working day during the previous twelve months Contractor must comply with the following Affirmative Action requirements for disabled workers:

20.31 Contractor must not discriminate against any employee or applicant for employment because of physical or mental disability in regard to any position for which the employee or applicant for employment is qualified. Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified disabled persons without discrimination based upon their physical or mental disability in all employment practices such as the following: Employment, upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

20.32 Contractor will comply with the rules and relevant orders of the Minnesota Department of Human Rights issued pursuant to the Minnesota Human Rights Act.

20.33 In the event of Contractor's noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance may be taken in accordance with Minnesota Statutes Section 363.073, and the rules of relevant orders of the Minnesota Department of Human Rights issued pursuant to the Minnesota Human Rights Act.

20.34 Contractor will post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the commissioner of the Minnesota Department of Human Rights. Such notices must state Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled employees and applicants for employment, and the rights of applicants and employees.

20.35 Contractor must notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that, Contractor is bound by the terms of Minnesota Statutes Section 363.073, or the Minnesota Human Rights Act and is committed to take affirmative action to employ and advance in employment physically and mentally disabled persons.

Article 21 Compliance with Licenses, Permits, and Other Regulations

21.1 Contractor must procure all licenses, permits, or other rights necessary to fulfill its obligations under this Contract in compliance with all applicable federal and state laws.

Article 22 Audits and Inspections

22.1 The books, records, documents, and accounting procedures and practices of Contractor relevant to this Contract are subject to examination by the State, Minnesota Department of Transportation, and/or Legislative Auditors, as appropriate, for a minimum of six years from the end of the project.

22.2 Duly authorized representatives of State (and the Federal Highway Administration, if federal funds are involved) have the right to inspect the work of Contractor under this Contract, during regular working hours, whenever it is deemed necessary to do so.

22.3 Work Effort Audits:

22.31 State may conduct work effort audits for the various work tasks described in the Special Terms. Audits will be randomly selected for completed work tasks. Audits will include work effort reviews and effort level analysis to determine the reasonableness of the hours charged.

22.32 Contractor must maintain work effort progress reports showing work tasks, hours worked on the task by the various personnel assigned to this work, and work effort performed by subcontractors assigned to the tasks. The progress report must be in the format as described in the Special Terms of this Contract.

Article 23 Government Data Practices and Intellectual Property

23.1 Government Data Practices. Contractor and State must comply with the Minnesota Government Data Practices Act, Minnesota Statutes Chapter13, as it applies to all data provided by State under this contract, and as it applies to all data created, collected, received, stored, used, maintained, or disseminated by Contractor under this contract. The civil remedies of Minnesota Statutes Section 13.08 apply to the release of the data referred to in this clause by either Contractor or the State.

If Contractor receives a request to release the data referred to in this Clause, Contractor must immediately notify State. State will give Contractor instructions concerning the release of the data to the requesting party before the data is released.

23.2. Intellectual Property Rights.

23.21 *Intellectual Property Rights of State.* State owns all rights, title, and interest in all of the intellectual property rights, including copyrights, patents, trade secrets, trademarks, and service marks in the Works and Documents *created and paid for under this contract.* Works means all inventions, improvements, discoveries (whether or not patentable), databases, computer programs, reports, notes, studies, photographs, negatives, designs, drawings, specifications, materials, tapes, and disks conceived, reduced to practice, created or originated by Contractor, its employees, agents, and subcontractors, either individually or jointly with others in the performance of this contract. Works includes "Documents." Documents are the originals of any databases, computer programs, reports, notes, studies, photographs, negatives, designs, drawings, specifications, materials, tapes, disks, or other materials, whether in tangible or electronic forms, prepared by Contractor, its employees, agents, or subcontractors, in the performance of this contract. The Documents will be the exclusive property of State and all such Documents must be immediately returned to State by Contractor upon completion or cancellation of this contract. To the extent possible, those Works eligible for copyright protection under the United States Copyright Act will be deemed to be "works made for hire." Contractor assigns all right, title, and interest it may have in the Works and the Documents to State. Contractor must, at the request of State, execute all papers and perform all other acts necessary to transfer or record State's ownership interest in the Works and Documents.

23.22 *Intellectual Property of Contractor.* Contractor retains title and interest in all of its standard details, plans, specifications, and engineering computation documents, ("Previously Created Works and Documents") whether in written or electronic form, which have been incorporated into the Works and Documents, but which were developed by Contractor independent of this contract. Contractor issues to State a royalty-free, nonexclusive, and irrevocable license to use the Previously Created Works and Documents.

23.23 *Notification.* Whenever contractor reasonably believes it, or its employees or subcontractors, has made an invention, improvement, or discovery (whether or not patentable) in the performance of this contract, and has or actually or constructively reduced it to practice Contractor will immediately give State's Authorized Representative written notice thereof, and must promptly furnish the Authorized Representative with complete information and/or disclosure thereon.

23.24 *Representation.* Contractor must perform all acts, and take all steps necessary to ensure that all intellectual property rights in the Works and Documents are the sole property of State, and that neither Contractor nor its employees, agents, or subcontractors retain any interest in and to the Works and Documents. Contractor represents and warrants that the Works and Documents do not and will not infringe upon any intellectual property rights of other persons or entities. Contractor will indemnify; defend, to the extent permitted by the Attorney General; and hold harmless State, at Contractor's expense, from any action or claim brought against State to the extent that it is based on a claim that all or part of the Works or Documents infringe upon the intellectual property rights of others. Contractor will be responsible for payment of any and all such claims, demands, obligations, liabilities, costs, and damages, including but not limited to, attorney fees. If such a claim or action arises, or in Contractor's or State's opinion is likely to arise, Contractor must, at State's discretion, either procure for State the right or license to use the intellectual property rights at issue or replace or modify the allegedly infringing Works or Documents as necessary and appropriate to obviate the infringement claim.

This remedy of State will be in addition to and not exclusive of other remedies provided by law.

23.25 *State's Reuse of Works and Documents.* If the Works and Documents created and paid for under this contract are engineering plans and specifications requiring the certification of a licensed professional engineer, State acknowledges that such plans and specifications have been created solely for the specific project covered by this contract and may not be suitable for reuse on other projects. Government Data Practices. The Minnesota Government Data Practices Act, Minnesota Statutes Chapter13, applies to this contract and all work performed under it. The act provides, inter alia, disclosure and non-disclosure requirements for all data provided to or by the State and civil remedies for failure to comply with the act.

23.3 The originals of reports, drawings, work sheets, plans, field notes, computations, and other project data must be relinquished to State:

23.31 Upon written notice of completion or termination of this Contract, or
23.32 Upon written notification by State, or
23.33 Upon final payment by State to Contractor for this Contract.

Article 24 Liability

24.1 Contractor must indemnify, save, and hold State, its agents, and employees harmless from any and all claims or causes of action, including attorney's fees incurred by State, arising from a negligent or otherwise wrongful act, or omission in the performance of this Contract by Contractor or Contractor's agents or employees. This clause will not be construed to bar any legal remedies Contractor may have for State's failure to fulfill its obligations pursuant to this Contract.

Article 25 Workers' Compensation

25.1 Any and all employees of Contractor, including its subcontractors, or other persons while engaged in the performance of any work or services required by Contractor under this Contract, will not be considered employees of State. Any and all claims that may arise under the Workers' Compensation Act of Minnesota on behalf of said employees, or other 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 Contractor's employees, or other person while so engaged on any of the work or services to be rendered, will in no way be the obligation or responsibility of State. Pursuant to Minnesota Statutes Section 176.182, acceptable evidence of compliance with Workers' Compensation insurance coverage requirements must be presented to State before State may enter into a contract with Contractor.

Article 26 Insurance

26.1 A certificate of insurance for each type of insurance required under this Contract must be filed with State's Authorized Agent within 30 days of execution of this Contract and prior to commencement of any work under this Contract. Each policy must contain a 30 day notice of cancellation, nonrenewal, or material change to all named and additional insured.

26.2 Contractor must maintain and furnish satisfactory evidence of the following insurance policies:

26.21 Loss by any means, of all data furnished to Contractor by State, and for partially completed data for which State has made payment.

26.22 **Workers' Compensation Insurance:** Contractor will provide Workers' Compensation insurance for all Contractor employees and, in case any work is subcontracted, Contractor will require the subcontractor to provide Workers' Compensation insurance in accordance with the statutory requirements of state of Minnesota, including Coverage B, Employer's Liability, at limits not less than $100,000.00 bodily injury by disease per employee; $500,000.00 bodily injury by disease aggregate; and $100,000.00 bodily injury by accident. Evidence of subcontractor's insurance must be filed with Contractor.

26.23 **Commercial General Liability:** Contractor will maintain insurance protecting Contractor from claims for damages for bodily injury, including sickness or disease, death, and for care and loss of services as well as from claims for property damage including loss of use which may arise from operations under this Contract whether such operations be by Contractor or by a subcontractor or by anyone directly or indirectly employed under this Contract. Unless otherwise specified within this Contract, Contractor's insurance minimum amounts will be as follows:

$1,000,000.00 - per occurrence
$2,000,000.00 - annual aggregate

In addition, the following coverages should be included:

Bodily Injury and Property Damage
Products and Completed Operations Liability
Blanket Contractual Liability
Name State as an Additional Insured

26.24 **Commercial Automobile Liability:** Contractor will maintain insurance protecting Contractor from claims for damages for bodily injury, including sickness or disease, death, and for care and loss of services, as well as from claims for property damage including loss of use which may arise from operations under this Contract whether such operations were by Contractor or by subcontractor or by anyone directly or indirectly employed under this Contract. Unless otherwise specified within this Contract, Contractor insurance minimum amounts will be as follows:

$1,000,000.00 - per occurrence Combined Single limit for Bodily Injury and Property Damage.

In addition, the following coverages should be included:

Owned, Hired, and Non-owned
Name State as an Additional Insured

26.25 **Professional/Technical, Errors and Omissions, and/or Miscellaneous Liability Insurance:** Unless otherwise specified within this Contract, Contractor insurance minimum amounts will be as follows:

$1,000,000.00 - per claim
$2,000,000.00 - annual aggregate.

On request, Contractor must submit a financial statement signed by a Certified Public Accountant which provides evidence that Contractor has adequate assets to cover any deductible which applies to this policy.

This policy will provide coverage for all claims Contractor will become legally obligated to pay resulting from any actual or alleged negligent act, error, or omission related to Contractor's professional services required under this Contract.

26.26 For work on railroad property, Contractor must obtain Railroad Protective Liability Insurance in accordance with Mn/DOT Specification 1708.2 (2000 Edition) or any subsequent changes or modifications to this specification.

26.3 Contractor must:

26.31 Include legal defense fees in addition to its liability policy limits, with the exception of 26.25 above; and

26.32 Obtain insurance policies from an insurance company having an "AM BEST" rating of A VI or better.

26.4 State reserves the right to immediately rescind this Contract if Contractor is not in compliance with the insurance requirements and retains all rights to pursue any legal remedies against Contractor. All insurance policies must be open to inspection by State, and copies of policies must be submitted to State's Authorized Agent upon written request.

Article 27 **Deliverable Standards**

27.1 State will have the authority to disapprove or reject services and/or goods that are defective. Contractor will be responsible for the accuracy of its work under this Contract and must make immediate, necessary revisions, repairs, or corrections without compensation resulting from errors and omissions on the part of Contractor.

Services and/or goods delivered under this Contract must be in accordance with applicable federal or state standards and/or specifications and must be of a quality that is satisfactory to State. Acceptance of the services and/or goods by State will not be considered a waiver of any provision of this Contract and will not relieve Contractor of the responsibility for subsequent correction of any such errors or omissions and the clarification of any ambiguities.

In the event revisions, repairs, or corrections to the deliverables must be made, Contractor must invoice State for any employee's time necessary to revise, repair, or correct errors or omissions at a rate of zero dollars per hour for the number of hours necessary to perform the work.

27.2 The services and/or goods provided to State by Contractor must be of such quality that they are suitable for their intended purpose which meets the design requirements provided for in the Special Terms.

27.3 Time is of the essence with respect to this Contract. In the event Contractor fails to perform its duties by the time fixed for the completion of the work, State may elect to immediately terminate this Contract.

27.4 Neither party will be held responsible for delay or failure to perform when such delay or failure is due to any of the following, unless the act or occurrence could have been reasonably foreseen and reasonable action could have been taken to prevent the delay or failure: fire, flood, epidemic, strikes, wars, acts of God, unusually severe weather, or delays or defaults caused by public carriers, provided the defaulting party gives written notice as soon as possible to the other party of its inability to perform.

Article 28 **Printing, Paper Stock, and Ink Requirements**

28.1 If this Contract results in reports or documents paid for by State, Contractor must comply with Minnesota Statutes Sections 16B.121 and 16B.122, for the purchase of printing, paper stock, and printing ink.

Article 29 **Publicity and Endorsements**

29.1 Any publicity given to the program, publications, or services provided resulting from this Contract, including, but not limited to, notices, informational pamphlets, press releases, research, reports, signs, and similar public notices prepared by or for Contractor or its employees individually or jointly with others, or any subcontractors must identify State as the sponsoring agency and must not be released without prior approval by the Commissioner of Transportation, unless such release is a specific part of an approved work plan included in this Contract.

29.2 Contractor must not claim that State endorses its products or services.

Article 30 **Officials not to Benefit**

30.1 Without prior written consent of State, Contractor must not employ any professional or technical personnel to provide services under this agreement who are or have been at any time during the time period of this Contract in the employ of State, except retired State employees, without written consent from State.

30.2 Contractor warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for Contractor, to solicit or secure this Contract, and that Contractor has not paid or agreed to pay any company or person, other than a bona fide employee working for Contractor, any fee, commissions, percentage, brokerage fee, gifts, or any other consideration, contingent upon or resulting from the award of making of this Contract.

Article 31 **Termination**

31.1 This Contract may be immediately terminated by State or the Commissioner of Administration, at any time, with or without cause, upon written notice to Contractor. In the event of such termination Contractor will be entitled to payment, determined on a pro rata basis, for services and/or goods satisfactorily performed or delivered.

31.2 In the event State cannot or does not obtain funding from the Minnesota Legislature, or funding cannot be continued at a level sufficient to allow for the purchasing of the services and/or goods contained herein, this Contract may be immediately terminated, at State's option, by written notice of termination delivered in person, by mail, or facsimile to Contractor at the address specified in this Contract. State will not be obligated to pay for any services and/or goods provided by Contractor after such notice of termination.

Article 32 **Errors and Omissions**

32.1 Contractor will be responsible for the accuracy of the work and must promptly make necessary revisions or corrections resulting from Contractor's errors, omissions, or negligent acts without additional compensation. Acceptance of the work by State will not relieve Contractor of the responsibility for subsequent correction of any errors or omissions or for clarification of any ambiguities.

It is understood by the parties that State will rely on the professional performance and ability of Contractor. Any examination by State or the Federal Highway Administration, or any acceptance or use of the work product of Contractor, will not be considered to be a full and comprehensive examination and will not be considered an approval of the work product of Contractor which would relieve Contractor from any liability or expense that could be connected with Contractor's sole responsibility for the propriety and integrity of the professional work to be accomplished by Contractor pursuant to this Contract.

32.2 At any time during construction or any phase of work performed by others based on data provided by Contractor, Contractor must confer with State when necessary for the purpose of interpreting the information secured and/or to correct any errors or omissions made by Contractor. Contractor must prepare any and all plans or data needed to correct the errors or omissions without added compensation, even though final payment may already have been received by Contractor. Contractor must give immediate attention to these changes so there will be minimal delay to the construction or other work as referenced.

32.3 If errors, omissions, or negligent acts are made by Contractor in any phase of the work, the correction of which may require additional field or office work, Contractor will be promptly notified by State and will be required to perform such additional work as may be necessary to correct these errors, omissions, or negligent acts without undue delay and without additional cost to State. If Contractor is aware of any errors, omissions, or negligent acts made in any phase of the work, the corrections of which may require any additional field or office work, Contractor must promptly perform such additional work as may be necessary to correct these errors, omissions, or negligent acts without undue delay and without additional cost to State.

32.4 Contractor will be responsible for any damages incurred as a result of its errors, omissions, or negligent acts and for any loss or cost to repair or remedy Contractor's errors, omissions or negligent acts. Acceptance of the work by State will not relieve Contractor of the responsibility for subsequent correction of any such errors, omissions, or negligent acts, or of liability for loss or damage resulting therefrom.

32.5 Contractor must respond to State's notice of any errors or omissions within 24 hours and give immediate attention to these corrections to minimize any delays to State. Notification will be by telephone, followed by Certified Mail. Contractor may be required to make a field review of the project site, as defined in the Special Terms, if directed by State's Authorized Agent and Contractor may be required to send personnel to the appropriate State district office as part of correcting any errors or omissions.

Article 33 Quality Assurance and Quality Control

33.1 Prior to approval and execution of this Contract, Contractor must have a Quality Assurance and Quality Control (QA/QC) Program. During the term of this Contract, Contractor must adhere to Contractor's QA/QC Plan, which was prepared by Contractor and accepted by State's Authorized Agent, for this Contract. Contractor's QA/QC Plan is incorporated into this Contract by reference. With each deliverable submitted to State pursuant to this Contract, Contractor must certify in writing to State's Authorized Agent that there was compliance with the QA/QC Plan. State may cancel this Contract for Contractor's failure to follow the QA/QC Plan for this Contract.

Article 34 Disputes

34.1 State's Authorized Agent will be the initial interpreter of the requirements of this Contract and will judge the acceptability of the work hereunder. Claims, disputes, and other matters relating to the acceptability of the work will be referred in writing to State's Authorized Agent, with a request for a formal decision to be rendered in writing within a reasonable time. Written notice of each such claim, dispute, or other matter must be delivered by Contractor to State's Authorized Agent within 15 working days of the occurrence of the event giving rise to the claim, dispute, or other matter. Written supporting data must be submitted to State's Authorized Agent within 45 days of each such occurrence, unless State's Authorized Agent allows an additional period of time to ascertain more accurate data.

The rendering of a decision by State's Authorized Agent will be a condition precedent to Contractor's exercise of such rights and remedies as it may have under this Contract or at law in respect to any claim, dispute, or other matter.

Article 35 Federal Clauses

If Federal Funds are involved with this Contract, the following additional conditions apply:

35.1 Federal reimbursement will be limited to the Federal share of costs which are allowable under the Federal cost principles contained in the Federal Acquisition Regulation, Contract Cost Principles and Procedures, 48 Code of Federal Regulations Section 31.

35.2 Contractor warrants and represents that State and the Federal Highway Administration will have a royalty-free, nonexclusive, and irrevocable license to reproduce, publish, or otherwise use for federal, state, or local government purposes, any patentable subject matter or copyrightable materials developed, or any rights of copyright to which State has purchased ownership, under this Contract.

When applicable, the patent rights provisions of 48 Code of Federal Regulations Section 27 will apply to this Contract regarding rights to inventions. Such provisions are incorporated by reference and must be incorporated in all subcontracts by reference.

35.3 Federal-Aid Contracts: Contractor acknowledges that by signing this Contract, it certifies to the best of its knowledge and belief:

35.31 That no Federal appropriated funds have been paid or will be paid, by or on behalf of Contractor, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract or the making, extension, continuation, renewal, amendment, or modification of any Federal grant, loan, or cooperative agreement.

35.32 That if any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, Contractor must complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

35.33 That this certification is a material representation of fact upon which reliance was placed when this transaction was made or entered. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 United States Code Section 1352. Any person who fails to file the required certification will be subject to a civil penalty.

35.34 That it must require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000.00 and that all such subcontractors must certify and disclose accordingly.

35.4 Contractor must comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act, 42 United States Code Section 7606; Section 508 of the Clean Water Act, 33 United States Code Section 1368; Executive Order Number 11738, and all applicable regulations promulgated by the United States Environmental Protection Agency.

Article 36 Data Disclosure

36.1 Contractor consents to disclosure of its social security number, federal employer tax identification number, and/or Minnesota tax identification number to federal and state tax agencies and state personnel involved in the payment of state obligations. These identification numbers may be used in the enforcement of federal and state tax laws which could result in action requiring Contractor to file state tax returns and pay delinquent state tax liabilities, if any. Minnesota Statutes Section 270.66.

THE BALANCE OF THIS PAGE IS INTENTIONALLY LEFT BLANK

Mn/DOT Agreement No. 85169

1. STATE ENCUMBRANCE VERIFICATION
Individual certifies that funds have been encumbered as required by Minn. Stat. §§ 16A.15 and 16C.05.

Signed:
Date: 5-28-2003
CFMS Contract No. A- 48811

2. CONTRACTOR

The Contractor certifies that the appropriate person(s) have executed the contract on behalf of the Contractor as required by applicable articles, bylaws, resolutions, or ordinances.

By:
Title: VP.
Date: 5-19-03

By: Dale N. Beckman
Title: Senior Vice President
Date: May 20, 2003

3. STATE AGENCY

By: ORIGINAL SIGNED BY Richard Stehr
(with delegated authority)
Title: Division Director
Date: 5-28-03

4. COMMISSIONER OF ADMINISTRATION

By:
Date: 5-28-03

5. ATTORNEY GENERAL
As to form and execution

By: ORIGINAL SIGNED BY JEFFERY THOMPSON
Date: 05/29/03

Mn/DOT Agreement No. 85169

Exhibit A
"Scope of Services"

WORK DESCRIPTION

Under this agreement the Contractor will participate with the State during its annual inspection of Bridge No. 9340. The Contractor has previously been selected by the State to evaluate fracture critical structural steel components of the bridge and to recommend potential mitigation strategies in the event any of these components fail. That evaluation will be performed under a comprehensive future agreement. Because the State has determined that the Contractor should actively participate in the bridge's annual inspection, and because the afore-mentioned future agreement will not be inplace and approved until after completion of the annual inspections, this Agreement No. 85169 is executed to allow the Contractor to gain insight into and perform a preliminary assessment of the bridge's current structural condition.

Task 1 - Data Collection
Review bridge plans, inspection data, and past research reports to determine specific bridge elements to be inspected.

Task 2 – Field Inspections
Accompany the State on at least two work-days of the annual inspection of Bridge No. 9340. Inspections are scheduled for the week of June 9, 2003. The Contractor will coordinate with the State their work schedule.

Inspections will be accomplished from the State's snooper bucket. Key inspections include the conditions at the transfer girder bearings and the upper chords over the piers. The Contractor will also note the general rate of corrosion.

Marks will be scribed near the bridge bearings for future monitoring to determine structure movement due to temperature variations.

The Contractor will not lead the inspection effort but will be present to assist the State's inspection team while obtaining information on existing structure conditions. The Contractor will document the condition of the structure with notes and photographs.

Task 3 – Inspection Report
The Contractor will prepare and deliver a brief report of findings.

Items Provided and Completed by State:
The following will be provided and/or completed by the State:

1. The State will provide snooper access required for the bridge inspection.
2. The State will lead annual inspection effort.

Mn/DOT Agreement No. 85169

Exhibit B
"Budget Table"

Employee Type	Estimated Hours	Hourly Rate ($/Hr)	Costs
Project Manager	12	$50.50	$ 606.00
Senior Engineer	28	$38.00	$ 1,064.00
Staff Inspector	28	$26.00	$ 728.00
Administrative	8	$21.00	$ 168.00
Total Direct Labor			$ 2,566.00
Overhead @ 130.26%			$ 3,342.47
Fixed Fee (12%)			$ 709.02
Sub Total			$ 6,617.49
Direct Expenses			
Photocopying			$ 100.00
Postage and Delivery			$ 10.00
Photo Reproduction			$ 60.00
Mileage (90 miles @ $0.36/mile)			$ 32.40
Total Direct Expenses			$ 202.40
Total Agreement Amount			**$6,819.89**

Mn/DOT Agreement No.85169
CFMS Contract No.______

Exhibit C Invoice

To: Consultant Services
Minnesota Department of Transportation
Transportation Building, Mail Stop 680
395 John Ireland Boulevard
St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Period Ending: ______
Invoice Date: ______

Copy: Robert J. Miller
Project Manager

INVOICE NO.____

Re: Mn/DOT Agreement No.: 85169 State Project Number: N.A.
Project Description: Bridge Inspection for Bridge No. 9340 (I-35W over Mississippi River)
Trunk Highway: 35W

Contract Expiration Date: December 31, 2003

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Salary Costs: (See Exhibit B for breakdown)	$ 2,566.00			
2. Overhead Costs: Rate = 130.26% (Direct Salaries * Overhead Rate)	$ 3,342.47			
3. Fixed Fee (Profit): (Fixed Fee = $ * percent complete)	$ 709.02			
4. Other Direct Costs: (Attach support documentation)	$ 202.40			
Net Earnings Totals:	$ 6,819.89			
			Total Amount Due This Invoice:	

For State Use Only

I certify that the above statement is correct and payment has not been received.

Signature: ______

Print Name: ______

Title: ______

Billing Address:
URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, Minnesota 55415
Telephone: (612) 370-0070

Approved for Payment:

______
Agreement Administrator Date

Rev. 8/02

Mn/DOT Agreement No. 85169

Exhibit D
Progress Report Form

To: Robert J. Miller
Project Manager

From: URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, Minnesota 55415

For Invoice no.: ________________ Billing Period: From ________ to ________
Contract Expiration Date: December 31, 2003
Type of Work: Bridge Inspection Project Description: Bridge Inspection for Bridge No. 9340 (I-35W over Mississippi River)
State Project Number: N.A. Trunk Highway: 35W

Task Description	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	% of Budget Hours Used
		% Work Completed This Period	% Work Completed to Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1- Data Collection	21%					16			
Task 2- Field Inspections	26%					20			
Task 3- Inspection Report	53%					40			
TOTALS:	100%					76			

I certify that the above statement is correct: Approved and recommended for payment:

Contractor's Project Manager State's Project Manager

If Budgeted Hours Used for task exceeds 100%, attach explanation.

This payment Progress Report must be submitted, within five working days after receipt, by State Project Manager for payment execution.

State of Minnesota
Department of Transportation
Bridge Office
3485 Hadley Avenue North
Oakdale MN 55128-3307
651-747-2100

ADD THIS
TO PREVIOUS
FAX

FACSIMILE TRANSMITTAL

To: Name: DON FLEMMING / MARK MAVES
Company: URS CORP.
Address:
Fax Number: (612) 370-1378
Date: 6-04-03 Time: 3:45 (3:20) pm
Number of Pages (including cover sheet): (21)-2
From: Name: BOB MILLER
Phone: (651) 747-2105
Subject: A 35W / MISSISSIPPI RIVER INSPECTION
Comments: MN/DOT AGREEMENT 85169 - BR 9340

ANNUAL INSPECTION BEGINS NEXT WEEK, JUNE 9, 2003.
CONTACT MARK PRIBULA 651-582-1418 TO COORDINATE
CONTACT ME FOR PROBLEMS.
~~HAVE~~ ORIGINAL COPY OF AGREEMENT IN MAIL

Please call 651/747-2100 if you do not receive a complete transmittal.

Minnesota Department of Transportation
Office of Bridges and Structures
3485 Hadley Avenue North
Oakdale, MN 55128-3307
M.S. 610

June 4, 2003

Mr. Donald J. Flemming, P.E.
URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, Minnesota 55415

In reference to: Mn/DOT Contract No. 85169
Bridge Inspection for Bridge No. 9340
I-35W over Mississippi River in Minneapolis

Dear Mr. Flemming:

Enclosed is your executed copy of the above referenced contract. This contract is for the inspection of Bridge No. 9340, 35W over the Mississippi River in Minneapolis.

This is your authorization to proceed. Please coordinate this project with Mark Pribula, Metro Structures Inspection Engineer at (651) 582-1418.

Please send to me a signed copy of any sub-consultant agreements for this project.

If you have any questions regarding this agreement, please contact me.

Sincerely,

Robert J Miller

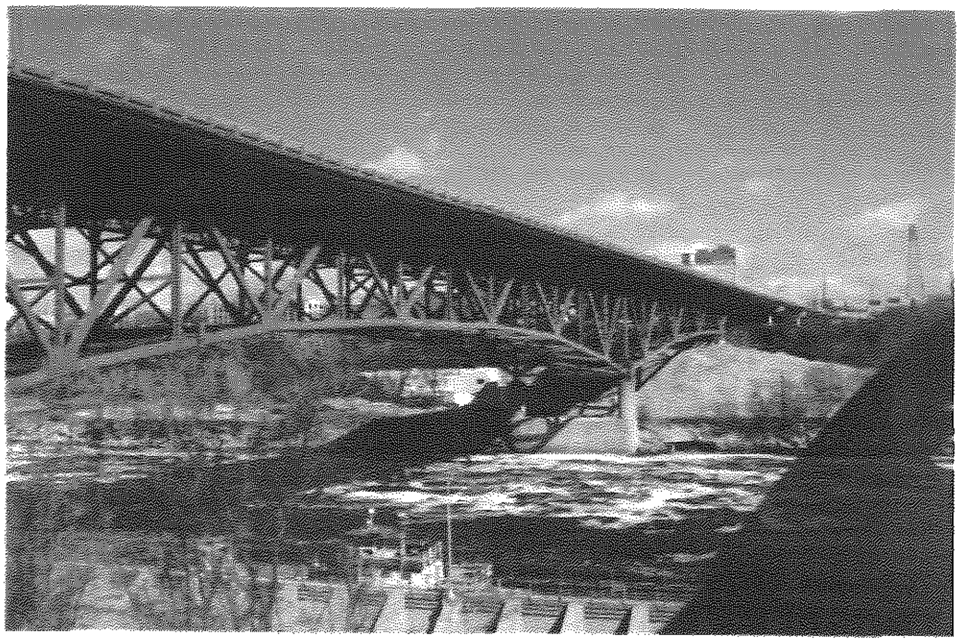
Robert J. Miller
Contract Administrator
(651) 747-2105 Phone
(651) 747-2108 Fax
bob.miller@dot.state.mn.us

Enclosure: Executed Mn/DOT Agreement 85169

cc: file
Mark Pribula (copy) /
Project Accounting (2 copies) M.S. 215

Initial Inspection Report For:

Fatigue Evaluation
Bridge 9340
35W Over Mississippi River



Prepared for:

Mn/DOT

Prepared by:

URS

Thresher Square
700 Third Street South
Minneapolis, MN 55414-1199

June 9th - June 13, 2003

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3. Bearing and Joint Marks for Future Reference 2

4. Inspection Effort of Fracture Critical Details 4

5. Future Inspections 5

6. Summary and Recommendations 5

Appendices
- Appendix A – Documented Photo Log
- Appendix B – Inspection Photographs
- Appendix C – Key Plans

1. INTRODUCTION

We have completed our limited field inspection of the main truss section of Bridge 9340 (TH 35W over the Mississippi River). The inspection was performed during MnDOT's normal inspection cycle on June 9, 2003 to June 13, 2003. A member of URS's staff participated with MnDOT inspection personnel in MnDOT's inspection to assess the existing structural condition of key superstructure components.

The purpose of the URS limited field inspection was to observe the overall condition of the truss members, floor beams, truss bearings, truss connections, miscellaneous connections and bracing members. URS was to mark the bearing position (for all truss bearings) and record the temperature so that observations of potential movement could be ascertained later. URS was to document the condition of key members and create a photo log of the inspection photographs to document the general condition of the truss on the inspection dates. Finally URS was to comment on the inspection effort of the fracture critical details within the truss.

Information will be presented by breaking the report into major topics followed by a brief discussion of the major items for each topic. The attached photo log and image CD can be referenced for specific pictures of various areas within the truss.

2. OVERALL CONDITION OF THE TRUSS

Corrosion and Deterioration of the Truss Members

See Appendix A, B, and C for photo log, inspection photographs, and key plans. The overall condition of the truss members was found to be in relatively good condition from a corrosion standpoint. Minimal surface rusting was found on the exterior of the truss members. Corrosion that was located on the truss members and connections was generally concentrated near the deck joints, leading to the conclusion that leakage from the bridge deck is contributing substantially to the corrosion. There was also corrosion within the truss chord members at the tab connection attachment of the internal diaphragms. This topic will be discussed in greater detail later in the report.

Bearing Conditions

- The roller bearings appeared to not be functioning as intended. There was significant corrosion of the bearing surfaces, debris and dirt packed into various areas of the bearing and very thick coatings of paint. The roller bearings appear to be "frozen" in place.
- The access to observe the rocker bearings was very difficult due to the construction details. The bearings are built into "pockets" in the floor beam with little clearance to the sides of the bearing. Some debris was noted in the pocket and it was impossible to visually determine if the bearings are functioning. The bearings were marked so that potential movements could be determined in the future under different temperature conditions. The bearing marking will be discussed in greater detail later in the report.
- Joint Conditions

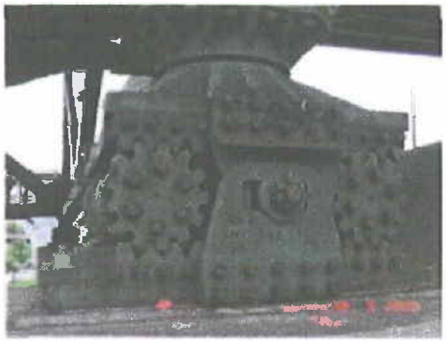
  The condition of the deck joints was found to be good except for a few bent fingers in the finger joints. However, the condition of the waterproofing was hard to determine. There was evidence that the deck joints had leaked or were currently leaking as indicated by the concentrated corrosion of the members at or near the deck joints.

Typical Condition of Expansion Bearing at Pier 6 (West Truss)

3. BEARING AND JOINT MARKS FOR FUTURE REFERENCE

URS planned to mark the bearings by scribing and by permanent marker in such a manner to determine if the bearings were moving (sliding, rolling or rocking) with changes in temperature. All of the expansion bearings were to be marked to document their current position.

Typical Marking of Rocker Bearings



Typical Field Marking of Roller Bearings

Typical Marking of Finger Joints

Pre-Inspection Concepts

Three lines of reference were planned for marking on the roller bearings.

- Line 1 was to be marked plumb from the upper casting across the center of one of the rollers and onto the lower bearing plate.
- Line 2 was to be marked horizontally across the tooth of the rollers onto the shield/hold down plate.
- Line 3 was to be marked vertically from the shield/hold down plate onto the underside of the upper plate.

Two lines of reference were planned for marking of the rocker bearings.

- Line 1 was to be marked plumb from the center on the rocker pin and extended down onto the supporting casting.
- Line 2 was to be marked along the centerline of one of the ribs of the bearing casting and projected down onto the supporting casting. The angle between the centerline of the rib and plumb line 1 was to be measured.

The deck joints were to be scribed with a line across the joint fingers to determine the relative movement of one set of fingers to the other or if possible two shallow holes were to be drilled and the distance between them measured.

Actual Bearing and Joint Markings

The actual marking of the bearings was much more difficult than anticipated. There were many projections of bolt heads and miscellaneous plates from the surface of the bearing components that made it extremely difficult to scribe lines. The rocker bearings were found to have almost no access to the side surfaces, and markings had to be improvised in the field.

Three lines were marked on the roller bearings.

- Line 1 was marked vertically from the upper casting across the center of one of the rollers, onto the lower bearing plate and extended onto the concrete surface. The line, however, could not be marked as plumb due to obstructions.

- Line 2 was marked horizontally across the tooth of the rollers onto the shield/hold down plate as planned.
- Line 3 was marked vertically from the shield/hold down plate onto the underside of the upper plate as planned.

One line was marked on the rocker bearing. It was not possible to mark the sides of the rocker bearing.

- Line 1 was marked on the rocker portion of the bearing a given distance up from the supporting casting. This line was also extended onto the supporting steel sole plate. The intent is to determine any change in the vertical distance between the rocker and the supporting plate and also any longitudinal displacement of the rocker in reference to the sole plate.

The deck joints were marked with shallow holes drilled into the joint fingers and the distance between the marks was measured.

TABLE OF MEASUREMENTS AND TEMPERATURES							
Location		Initial Marking (6-9-03 to 6-13-03)			Future Marking		
		Reference Line	Measurement	Temperature	Reference Line	Measurement	Temperature
Finger Joints	NW Corner	-	6 in	70 deg F	-		
	SW Corner	-	7 in	66 deg F	-		
	SE Corner	-	7 in	62 deg F	-		
	NE Corner	-	5 in	66 deg F	-		
Rocker Bearing	East Truss U0	Line 1	2 13/16 in	67 deg F	Line 1		
	East Truss U28	Line 1	3 15/16 in	68 deg F	Line 1		
	West Truss U0	Line 1	See Note		Line 1		
	West Truss U28	Line 1	See Note		Line 1		
Pier 5	West Truss	Line 1	0	68 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		
	East Truss	Line 1	0	66 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		
Pier 6	West Truss	Line 1	0	68 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		
	East Truss	Line 1	0	67 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		

Pier 8	West Truss	Line 1	0	63 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		
	East Truss	Line 1	0	68 deg F	Line 1		
		Line 2	0		Line 2		
		Line 3	0		Line 3		

Note: Bearing was not marked on initial visit because the lack of access prohibited the inspector from following the pre inspection marking plan. After review with office staff, an alternate marking concept was developed. Marking of the bearing on the following inspection days would have required an additional lane closure. Base line marks will be made on the next inspection.

4. INSPECTION EFFORT OF FRACTURE CRITICAL DETAILS

Inspection of Weld Tabs Within the Truss Members at the Diaphragms

The access holes in the truss members are currently covered and are not readily accessible without removal of the cover plates. The cover plates were removed at selected locations for observation of the interior of the truss chord at diaphragm locations. Minor amounts of corrosion were found to be present within the truss member with corrosion being concentrated at the welded tab connections and on the diaphragms themselves.

It was difficult to determine if the diaphragm was welded to the truss chord or only to the tabs within the member. Access holes are not located directly adjacent to the diaphragm locations and the diaphragms were visually observed from a distance. There was also an accumulation of debris/dirt around the perimeter of the diaphragms inspected. It appeared that the tabs were attached to the interior of the truss by welding with fillet welds in the longitudinal direction.

Back Side of Internal Diaphragm (Appears Welded)

Front Side of Internal Diaphragm (Weld Tabs)

Possible Visual Access Methods

Further visual inspection of the tab connections and diaphragms could be made by removal of more of the cover plates.

Probing scopes could also be utilized to provide up close inspection of the tab connections and diaphragms. Scopes with photographic capabilities would prove to be extremely valuable for documenting and determining the condition at these internal tabs.

5. FUTURE INSPECTIONS

Special Emphasis on Inspection of Fracture Critical Details

The length of the longitudinal weld of the tab connection should be determined to determine what stress category is appropriate for this condition. It should also be determined whether or not the diaphragm is welded to the interior of the truss member or just connected with the tab welds. The truss chord members are critical non-redundant members, thus emphasizing the need to fully investigate the fatigue condition.

Removing the cover plates at each of the diaphragm locations to inspect the truss interior at the tab connections is of critical importance. This is one of the primary locations that one would expect a critical fatigue crack to develop in a truss chord member.

MnDOT Assistance for One Additional Inspections

MnDOT will provide access to the bridge with an under bridge inspection unit for one additional inspection of the key truss members during the fatigue study.

Additional Inspections of Bearings and Joints

URS will monitor and record bearing and joint marks, for movement at a minimum of six different seasonal temperatures. URS will determine bearing and joint conditions and movement- temperature relationships based on these inspection records. URS will provide access equipment for a minimum of five additional bearing and joint inspections.

6. SUMMARY AND RECOMMENDATIONS

See Appendix A, B, and C for photo log, inspection photographs, and key plans. The overall condition of the truss members and connections was, from a corrosion standpoint, found to be good. Corrosion was found in localized areas, generally concentrated near the deck joints. Minor corrosion was observed at some of the locations chosen to inspect in the interior of the truss members.

The roller bearings did not appear to be moving freely due to the corrosion, debris and paint build up. The rocker bearings were not accessible for detailed visual observation and assessment of their movement. All of the bearings were marked in their current position and temperature readings were recorded to assist in determining movement-temperature relationships.

The fracture critical details at the tab locations on the interior of the box chord are very difficult to observe. The access openings are covered and observations can only be made after the cover plate is removed. It is our understanding that the cover plates are not being removed as part of MnDOT's regular inspection cycle. MnDOT should consider inspection of all of these fracture critical details as part of the normal inspection cycle due to the fracture potential of these details. Inspection of these details is clearly the most important part of future inspections of this structure. It is also recommended that scope equipment be procured to enable close visual inspection of these details.

Appendix A - Documented Photo Log

Appendix A

This photo log is a listing by photo number of the pictures taken during the inspection from June 9th to June 13th, 2003, including the location and a description. The photos can be found in Appendix B. Key plans explaining joint number descriptions in the photo log can be found in Appendix C.

A CD containing the image files has been included with this report.

PHOTO	LOCATION	DESCRIPTION
1-1	Pier 8 Bearing Assembly	West side – west face 63°F air temperature
1-2	Pier 8	North roller
1-3	Pier 8	South roller
1-4	Pier 8	West face Flaking rust
1-5	Pier 8	Southwest corner assembly
1-6	Pier 8	South face looking north
1-7	Pier 8	Connection looking north
1-8	Pier 8	Connection looking north
1-9	Pier 8	West side assembly East face L-27 connection Flaking rust
1-10	Pier 8	West side assembly East face L-27 connection

PHOTO	LOCATION	DESCRIPTION
1-11	Pier 8	West bearing East face
1-12	West truss inside box L-26 to L-27 15'+ from Pier 8	Inside box beam truss Looking south
1-13	West truss inside box L-26 to L-27 15'+ from Pier 8	Inside box beam truss Looking north
1-14	Pier 8 assembly North side Looking south	Flaking rust
1-15	Pier 8 North side Looking south	Connection plate
1-16	West truss North rocker U27	North face Looking south Panel PT north side
1-17	West truss North rocker U27	North face Looking south Panel PT north side
1-18	U27	Panel PT Connection plate at rocker Good condition East face looking west

PHOTO	LOCATION	DESCRIPTION
1-19	U27	Connecting plate West face looking east
1-20	U27	Connecting plate West face looking east
1-21	Opening in truss beam West truss U28 ⇒ L27	Inside looking south
1-22	Opening in truss beam West truss U28 ⇒ L27	Inside looking north
1-23	West truss U27 At rocker	West face looking east
1-24	West deck near Pier 8	Conduit connection on west coping
1-25	West deck near Pier 8	Conduit connection on west coping
1-26	Between L25 and L26 West side	Sign blister Connection south face Looking north Major flaking rust
1-27	Between L25 and L26 West side	Sign blister connection North face Looking south

PHOTO	LOCATION	DESCRIPTION
1-28	Between L25 and L26 West side	Sign blister connection North face Looking south
1-1	West truss South end at Rocker UO to L1	Rocker UO to L1 West face Looking east
2-2	West truss South end at Rocker UO to L1	Rocker UO to L1 West face Looking east
2-3	West truss South end at Rocker UO to L1	South face Looking north Rocker movement not marked
2-4	West truss South end at Rocker UO to L1	East face Looking west
2-5	West truss South end at Rocker UO to L1	Rocker South face looking north
2-6	West truss South end at Rocker UO to L1	Rocker South face looking north

PHOTO	LOCATION	DESCRIPTION
2-7	West truss South end at Rocker UO to L1	Rocker South face looking north
2-8	Pier 5 Bearing assembly	West face looking east Scribe marks 68°F Flaking rust Rust on teeth (south)
2-9	Pier 5 Bridge assembly	West face looking east Scribe marks 68°F Flaking rust Rust on teeth (south)
2-10	UO ⇒ L1	Connection flaking rust
2-11	UO ⇒ L1	Connection flaking rust
2-12	UO ⇒ L1	Connection flaking rust
2-13	Pier 5 Assembly	North face looking south
2-14	Pier 5 Assembly	North face looking south Showing east face connection
2-15	Pier 5 West truss	South face looking north
2-16	Pier 5 West truss	East face looking west

PHOTO	LOCATION	DESCRIPTION
2-17	Pier 5 West truss	East face looking west
2-18	L2 to L1 12' ± from L1	Inside box Looking south
2-19	L2 to L1 12' ± from L1	Inside box Looking north
2-20	L2 to L1 15' ± from L1	Inside box looking south
2-21	L2 to L1 15' ± from L1	Inside box looking north
2-22	Finger joint Northwest corner at Pier 8	Drilled hole in finger joint approx 6" apart at 70°F
2-23	Finger joint northwest corner at Pier 8	Drilled hole in finger joint approx 6" apart at 70°F
3-1	U22 west truss Connection west face Looking east	No visible rust
3-2	U22 west truss north side connection	No visible rust
3-3	U22 west truss south side connection	No visible rust

PHOTO	LOCATION	DESCRIPTION
3-4	U22 west truss East face Looking southwest	Good condition
3-5	U22 west truss East face looking southwest	Good condition Floor beam also
3-6	L21 to U22 member mid-point	Flaking rust
3-7	U22 west truss East face looking west	Good condition
3-8	U22 west truss East face looking west	Good condition
3-9	West truss U21 connection east face looking southwest	Good condition
3-10	West truss U21 connection east face looking southwest	Good condition
3-11	West truss U21 Floor beam connection at U21 East face looking west	
3-12	U21 to U22 2' north U21	Tack crack inside box

PHOTO	LOCATION	DESCRIPTION
3-13	U21 to U22 north U21 2'	Inside box Top chord flaking beam connection Weld crack upper left corner looking south
3-14	U21 to U22 north U21 2'	Inside box Top chord flaking beam connection Weld crack upper left corner looking south
3-15	U21 to U22 north U21 2'	Inside box Looking north
3-16	U21 connection West truss East face looking northwest	Good condition
3-17	U21 connection West truss East face looking northwest	Good condition
3-18	Walkway at U21	Interior bay
3-19	U20 connection East face looking west	Good condition
3-20	U20 connection East face looking west	Good condition

PHOTO	LOCATION	DESCRIPTION
3-21	L20 Pier 7 West face Looking northeast	Flaking rust Rust pits on member Bott bolts in bearing assembly Looks solid
3-22	L20 Pier 7 West face Looking northeast	Flaking rust Rust pits on member Bott bolts in bearing assembly Looks solid
3-23	L20 Pier 7 West face Looking northeast	Column cracking at Pier 7
3-24	L20 Pier 7 West face Looking southeast	Lower chord with flaking rust Connection flaking rust U20 to L20 With flaking rust
3-25	L20 Pier 7 West face Looking Southeast	Lower chord with flaking rust Connection flaking rust U20 to L20 With flaking rust
3-26	L20 Pier 7 East face Looking southwest Pier 7 west truss	Lower chord with flaking rust Connection flaking rust U20 to L20 With flaking rust

PHOTO	LOCATION	DESCRIPTION
3-27	L20 Pier 7 East face Looking southwest Pier 7 west truss	Lower chord with flaking rust Connection flaking rust U20 to L20 With flaking rust
3-28	Pier 7 Looking north	Flaking rust
3-29	L19 East face Looking southwest	Connection good condition
3-30	L19 West face Looking East	Flaking rust
3-31	U20 West face Looking northeast	Paint flaking
3-32	U20 West fact Looking northeast	Paint flaking
4-1	U19 West face Looking northeast	Good condition

PHOTO	LOCATION	DESCRIPTION
4-2	U19 East face Looking northwest	Good condition
4-3	U20 East face Looking northwest	Good condition
4-4	U18 East face Looking southwest	Good condition
4-5	U18 East face Looking southwest	Good condition
4-6	U18 West face Looking east	Good condition
4-7	U18 West face Looking east	Good condition
4-8	U18 West Face Looking northeast	Good condition
4-9	U18 West Face Looking northeast	Good condition

PHOTO	LOCATION	DESCRIPTION
4-10	U18 East face Looking northwest	Good condition
4-11	Not Used	
4-12	Not Used	
4-13	Finger joint at southwest corner	Drill holes approx. 7" apart at 66ºF 10:35 AM
4-14	Finger joint at southwest corner	Drill holes approx. 7" apart at 66ºF 10:35 AM
4-15	Finger joint at southwest corner	Drill holes approx. 7" apart at 66ºF 10:35 AM
4-16	West truss U6 connection West face looking east	Good condition
4-17	West truss U6 connection West face looking east	Good condition
4-18	East face U6 Looking west	Good condition
4-19	East face U6 Looking west	Good condition

PHOTO	LOCATION	DESCRIPTION
4-20	Sign blistering at U6	
4-21	Sign blistering at U6	
4-22	West truss U6 connection East face Looking southwest	Good condition
4-23	U7 East face Looking northwest	Good condition
4-24	U7 East face Looking northwest	Good condition
4-25	U7 West face Looking northeast	Good condition
4-26	U7 West face Looking southeast	Good condition
4-27	U7 East face Looking southwest	Good condition

PHOTO	LOCATION	DESCRIPTION
4-28	U8 East face Looking northwest	Good condition
4-29	U8 West face Looking east	Slight surface rust Drain connection
4-30	U10 East face Looking southwest	Walkway connection Good condition
4-31	U10 East face Looking southwest	Walkway connection Good condition
4-32	U10 West face Looking southeast	Good condition U of M sensor
4-33	U10 West face Looking east	Good condition U of M sensor
5-1	U10 West face Looking east	Good condition U of M sensor
5-2	U10 East face Looking northwest	Good condition U of M sensor

PHOTO	LOCATION	DESCRIPTION
5-3	U10 East face Looking northwest	Good condition U of M sensor
5-4	U10 East face Looking northwest	Good condition U of M sensor
5-5	U9 East face Looking southwest	Good condition
5-6	U9 East face Looking southwest	Good condition
5-7	U9 West face Looking southeast	Good condition
5-8	U9 West face Looking northeast	Good condition
5-9	U9 East face Looking northwest	
5-10	U8 East face Looking southwest	Good condition

PHOTO	LOCATION	DESCRIPTION
5-11	U8 East face Looking southwest	Good condition
5-12	U8 West face Looking southeast	Slight flaking rust Drain pipe (plugged) cause rust
5-13	U8 to L8	Rust due to plug drain
5-14	U8 to L8	Rust due to plug drain
5-15	U8 West face Looking east	Flaking rust
5-16	Drain connection at U8	
5-17	Expansion bearing Pier 6 West face Looking east	Major flaking rust and debris
5-18	Pier 6 North roller West face	Close up marks
5-19	Pier 6 South roller West face	Flaking rust

PHOTO	LOCATION	DESCRIPTION
5-20	Pier 6 Expansion assembly North face Looking east	
5-21	Pier 6 South face Looking east	Flaking rust
5-22	East face Looking north	Concrete column Good shape No major cracking
5-23	East face Looking north	Flaking rust
5-24	L15 West face Looking east	Slight flaking rust
5-25	L15 East face Looking west	Good condition
5-26	L15 East face Looking west	Good condition
5-27	L14 East face Looking southwest	Good condition

PHOTO	LOCATION	DESCRIPTION
5-28	L14 East face Looking southwest	Good condition
5-29	L14 West face Looking east	Good condition
5-30	L13 West face Looking east	Flaking rust on all members
5-31	L13 East face Looking southwest	Good condition
5-32	L13 East face Looking southwest	Good condition
6-1 6/10/03	U14 Upper Lateral stringer	Cracked tack weld
6-2	U14 Upper Lateral stringer	Cracked tack weld
6-3	U14 Upper Lateral stringer	Cracked tack weld

PHOTO	LOCATION	DESCRIPTION
7-1 6/11/03	Southeast corner finger joints Northbound lane east side	Drilled hole in fingers joint Approx 7"± apart Air temperature 62°F 10:20 AM
7-2	Southeast corner finger joints Northbound lane east side	Drilled hole in fingers joint Approx 7"± apart Air temperature 62°F 10:20 AM
7-3	Northbound lane 2nd Lane from east near river road	De - Lam MnDOT to patch
7-4	Northbound lane 2nd Lane from east near river road	De – Lam MnDOT to patch
7-5	Northbound lane 2nd Lane from east near river road	De – Lam MnDOT to patch
7-6	Northeast corner finger joint Northbound lane	Drilled hole in finger joint approx. 5"± apart 66°F 10:35 AM 6-11-03
7-7	Northeast corner finger joint Northbound lane	Drilled hole in finger joint approx. 5" ± apart 66°F 10:35 AM 6-11-03

PHOTO	LOCATION	DESCRIPTION
7-8	East truss U28 Northeast corner North face Looking south	Rocker at 67°F 2-13/16"
7-9	East truss U28 Northeast corner North face Looking south	
7-10	East truss U28 Northeast corner North face Looking south	Rocker at 67°F 2-13/16"
7-11	U28 = Rocker East face Looking west	Good condition
7-12	U28 = Rocker East face Looking west	Good condition
7-13	U28 West face Looking east	Good condition

PHOTO	LOCATION	DESCRIPTION
7-14	U28 West face Looking east	Good condition
7-15	Pier 8 East truss Expansion bearing assembly East face Looking west	Show good condition Concrete column in good condition Good condition Flaking rust on L27 to L26
7-16	Pier 8 East truss Expansion bearing assembly East Face Looking west	Show good condition Concrete column in good condition Good condition Flaking rust on L27 to L26
7-17	L27 Pier 8 Assembly	South face Looking north
7-18	L27 Pier 8	West face Looking northeast
7-19	L27 Pier 8 Connection	Slight flaking rust

PHOTO	LOCATION	DESCRIPTION
7-20	L27 Pier 8 Connection North face Looking southwest	
7-21	L27 Pier 8 Connection North face Looking southwest	Good condition
7-22	L27 Pier 8 Connection North face Looking south	
7-23	L27 connection East face Looking west	
7-24	East truss inside box L2 to U28 looking south 10' from L27	
7-25	East truss inside box L2 to U28 looking north	

PHOTO	LOCATION	DESCRIPTION
7-26	East truss inside box L2 to U28 looking south	
7-27	Pier 8 South face Looking north	Column good condition
7-28	East truss L27 to L26 21' from L26 Looking north	Inside box truss
7-29	East truss L27 to L26 21' from L26 Looking South	Inside box truss
7-30	East truss UO Rocker Near Pier 5 South face Looking north	Retro fit 68ºF 3-15/16"
7-31	UO South face Looking north	
8-1 6/11/03	UO Rocker East face Looking west	Good condition

PHOTO	LOCATION	DESCRIPTION
8-2	Pier 5 Expansion bearing assembly east truss East face Looking west	Good condition
8-3	Pier 5 Expansion bearing assembly East face Looking west Showing connection	
8-4	Pier 5 Expansion bearing assembly North face Looking southwest	
8-5	West face Looking northeast	Slight flaking rust
8-6	Pier 5 West face Looking northeast	Column good condition
8-7	Pier 5 West face Looking northeast	
8-8	Pier 5 West face Looking northeast	Column good condition

PHOTO	LOCATION	DESCRIPTION
8-9 6/12/03	East truss U22 – U6 Connection	Good condition West face Looking southeast
8-10	East truss U22 – U6 Connection	East face Looking southwest
8-11	East truss U22 – U6 Connection	East face Looking west
8-12	East truss U22 – U6 Connection	West face Looking northeast
8-13	U21 connection East truss	West face Looking southeast
8-14	U21 connection East truss	East face Looking southwest
8-15	U21 to U22 Inside box 8' North of U21	Looking south
8-16	U21 to U22 Inside box 8' North of U21	Looking north

PHOTO	LOCATION	DESCRIPTION
8-17	U21 to U22 inside box 16' north of U21	Looking south
8-18	U21 to U22 inside box 16' north of U21	Looking north
8-19	U21 East face Looking northwest	Good condition
8-20	U21 East truss	West face Looking northeast
8-21	U20 to U21 inside box truss 8' south U21	Looking south
8-22	U20 to U21 inside box truss 8' south U21	Looking north
8-23	U20 Pier 7	Good condition West face Looking southeast
8-24	U20 Pier 7	East face Looking southwest Good condition
8-25	Pier U20	East face Looking northwest

PHOTO	LOCATION	DESCRIPTION
8-26	Pier U20	West face Looking northeast
8-27	U19 connection	West face Looking southeast Good connection
8-28	U19 connection	East face Looking southwest Good condition
8-29	U19 to U20 inside box 8' ± to U19	Looking south
8-30	U19 to U20 inside box 8' ± to U19	Looking north
8-31	U18 to connection	East face Looking southwest Good condition
8-32	U19	East face Looking northwest
9-1	U19	West face Looking northeast Good condition
9-2	U18	West face Looking south Good condition

PHOTO	LOCATION	DESCRIPTION
9-3	U18	East face Looking west
9-4	Pier 7 Fixed Assembly	Assembly good condition Slight flaking rusty concrete column condition. Looks good South face Looking north
9-5	Pier 7	Flaking rust on connection Assembly bolts - Look good East face Looking northwest
9-6	Pier 7	East face Looking north
9-7	Pier 7	South face Looking north
9-8	Pier 7	North face Looking southwest
9-9	Pier 7	North face Looking south
9-10	East truss U6	Connection good condition East face Looking southwest

PHOTO	LOCATION	DESCRIPTION
9-11	U6 Connection Good condition	West face Looking southeast
9-12	U7	Connection good condition West face Looking northeast
9-13	Not Used	
9-14	U7 Connection	East face Looking southwest Good condition
9-15	U8 Connection	West face Looking northeast Good condition
9-16	U7 to U8 East truss inside box 14' + U7 near center	Looking south
9-17	U7 to U8 East truss inside box 14' ± U7 near center	Looking south
9-18	U7 to U8 East truss inside box 14' ± U7 near center	Looking north

PHOTO	LOCATION	DESCRIPTION
9-19	U7 to U8 East truss inside box 14' ± U7 near center	Looking north
9-20	U7 to U8 East truss inside box 14' south U8	Looking south
9-21	U7 to U8 East truss inside box 14' south U8	Looking north
9-22	U8 connection	East face Looking northwest Some rust Drain connection
9-23	U8 East truss	East face Looking southwest
9-24	U8 East truss	West face Looking southeast
9-25	U10 East truss connection	Good condition West face Looking southeast
9-26	U10	East face Looking west U of M Sensors

PHOTO	LOCATION	DESCRIPTION
9-27	U9 to U10 inside box 15' ± south U10	Looking south
9-28	U9 to U10 inside box 15' ± south U10	Looking north
9-29	U10	West face Looking northeast
9-30	U9 Connection	Good condition West face Looking southeast
9-31	U9	East face Looking southwest
9-32	U9	East face Looking northwest
10-1	East truss U8 to U9 Inside box	Looking south
10-2	East truss U8 to U9 Inside box	Looking south
10-3	East truss U8 to U9 Inside box	Looking north

PHOTO	LOCATION	DESCRIPTION
10-4	U8	West face Looking southeast
10-5	U8	West fact Looking southwest Upper lateral bracing Flaking rust
10-6	Pier 6 Expansion bearing assembly	East face Looking west Flaking rust No apparent movement
10-7	Pier 6 Expansion bearing assembly	East face Looking west Flaking rust No apparent movement
10-8	Pier 6 Expansion bearing assembly	East face Looking northwest Connection flaking rust
10-9	Pier 6 Expansion bearing assembly	West face Looking northeast Flaking rust on vertical and lower bracing
10-10	Pier 6 Expansion bearing assembly	West side Looking southeast

PHOTO	LOCATION	DESCRIPTION
10-11	Pier 6 Expansion bearing assembly	
11-1 6/13/03	East truss L12 to L13 Inside box 12' ± south of U13	Looking south
11-2	East truss L12 to L13 Inside box 12' ± south of U13	Looking north
11-3	L13 connection East face Looking west	Good condition Slight flaking rust
11-4	L13 connection West face Looking northeast	Flaking rust
11-5	Action Shot	
11-6	L12 to L14 10' ± north L13 Inside box	Looking south
11-7	L12 to L14 10' ± north L13 Inside box	Looking south Flaking rust at bottom Deck above

PHOTO	LOCATION	DESCRIPTION
11-8	L12 to L14 10' ± north L13 Inside box	Looking north
11-9	L13 Lower lateral bracing Connection	Flaking rust Deck drain above
11-10	L13 to L14 Inside box 12' ± south U14	Looking south Crack noted in 98
11-11	Not Used	Looking north
11-12	L14 connection Action Shot	
11-13	Not Used	
12-1	L14 East face Looking northwest	Good condition
12-2	L14 West face Looking southeast	
12-3	L14 West face Looking south	

PHOTO	LOCATION	DESCRIPTION
12-4	L14 to L15 Inside box 4' south L15	Looking south
12-5	L14 to L15 Inside box 4' south L15	Looking north
12-6	L15 connection	East face Looking west Good condition
12-7	L15 connection	West face Looking east

Appendix B - Inspection Photographs

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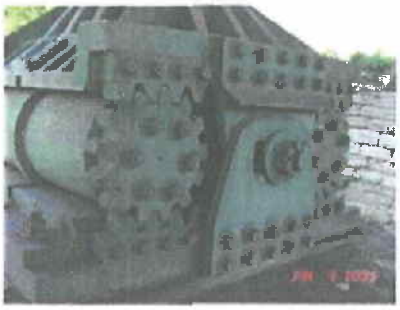

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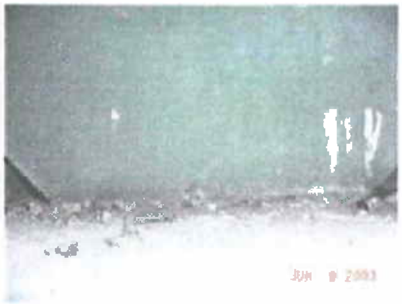

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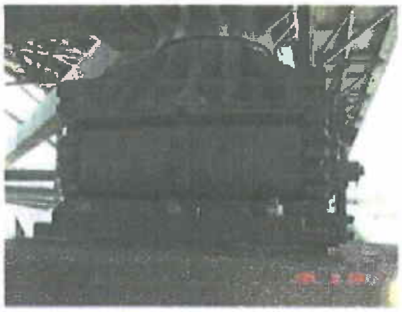

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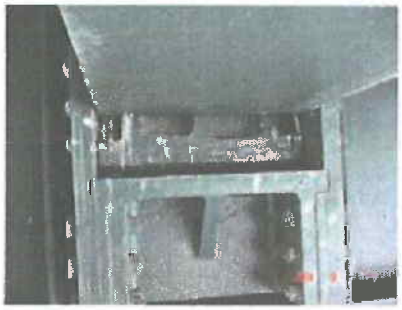

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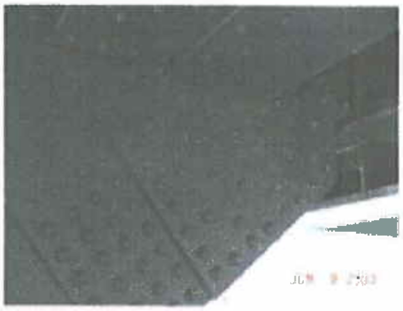

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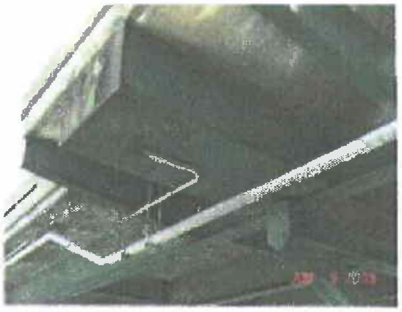

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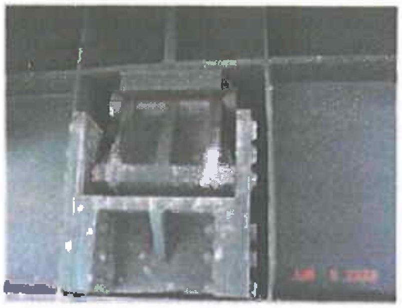

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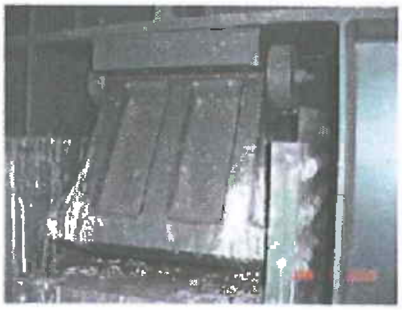

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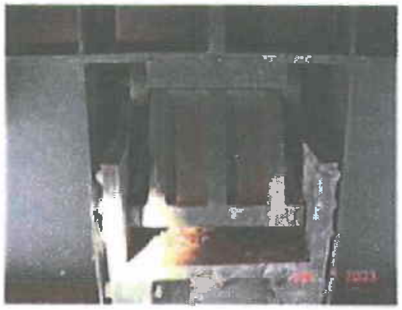

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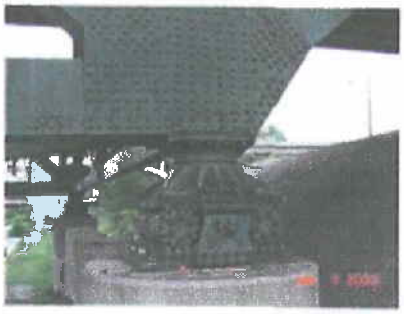

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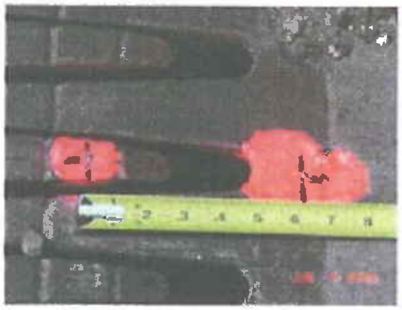

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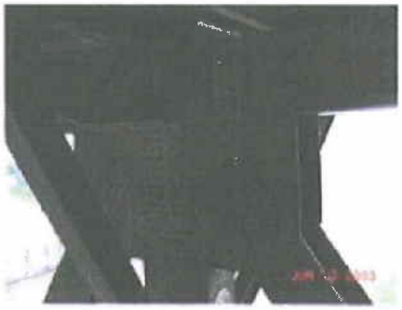

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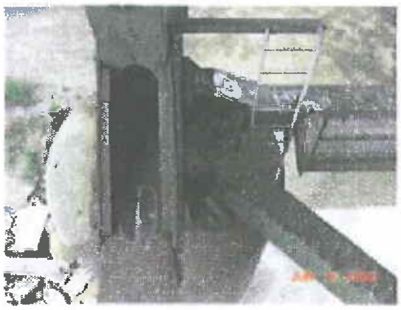

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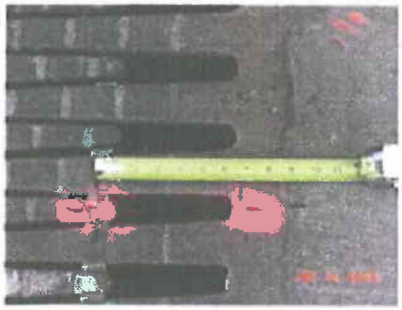

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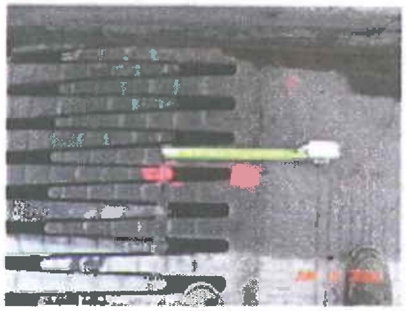

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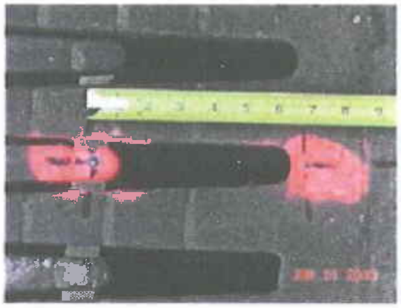

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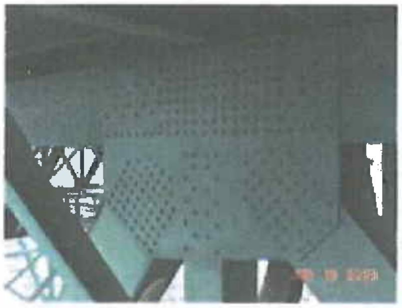

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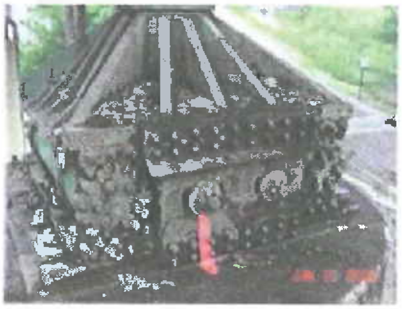

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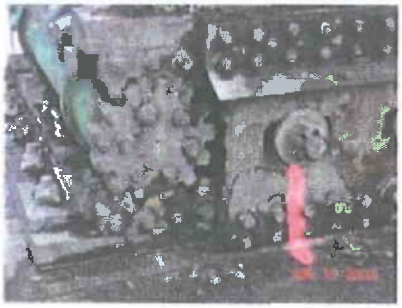

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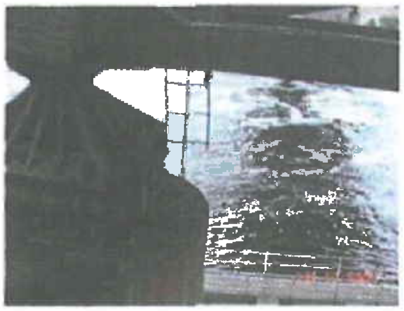

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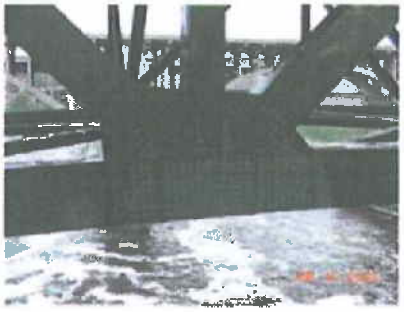

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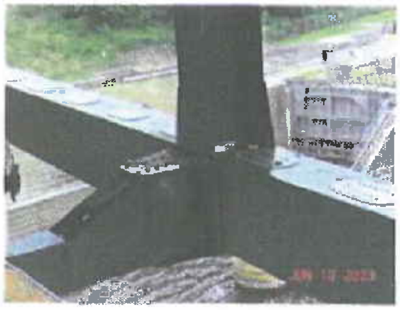

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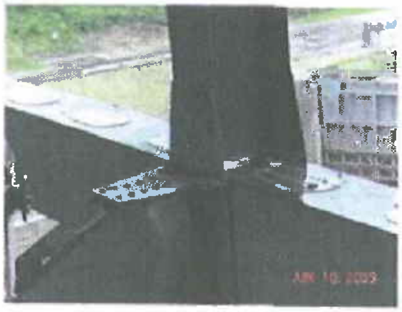

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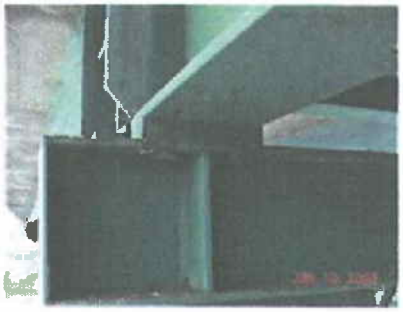

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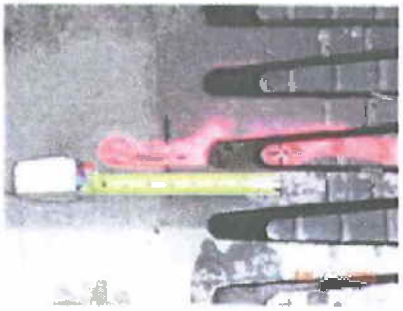

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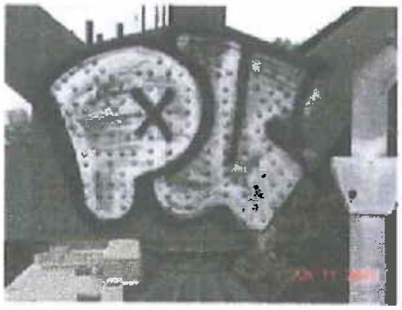

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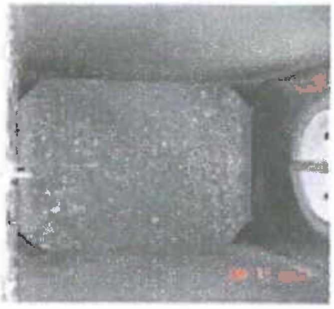

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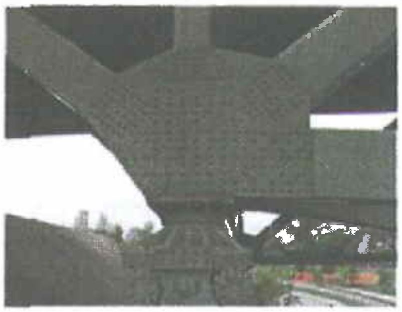

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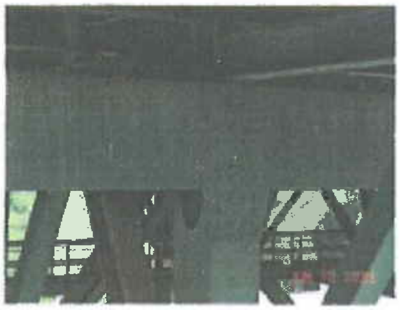

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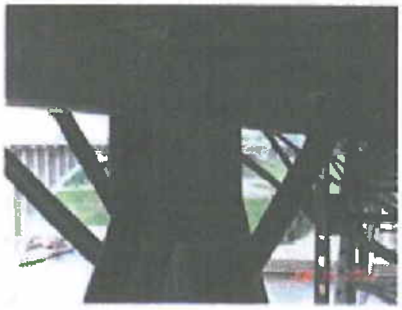

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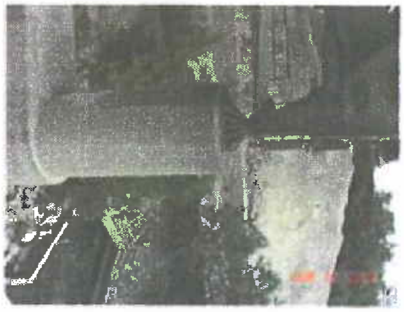

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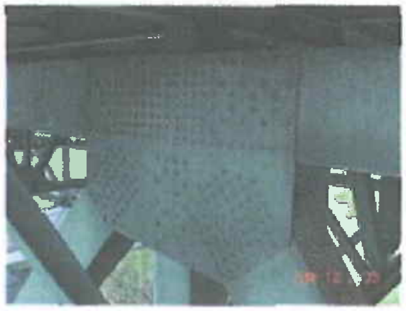

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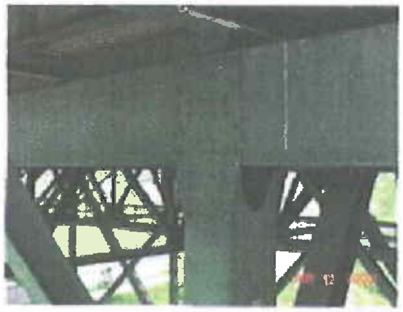

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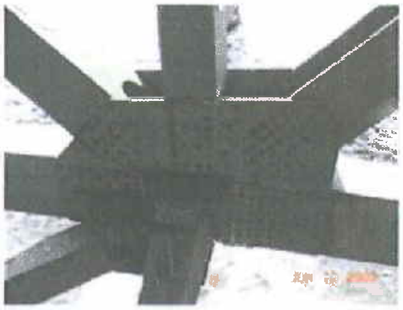

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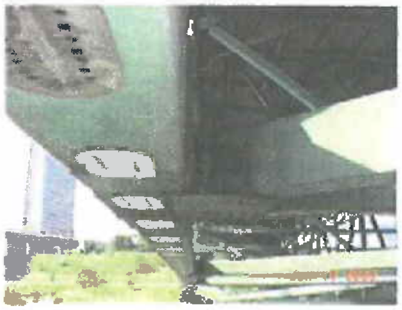

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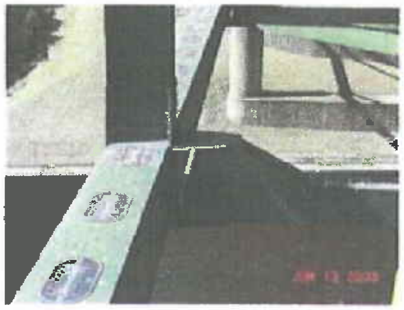

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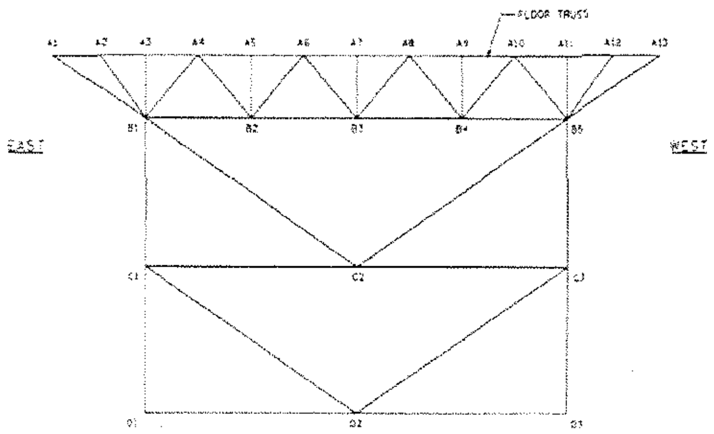
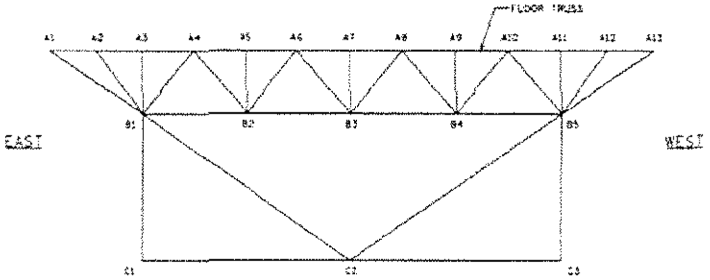
Appendix C - Key Plans



FLOOR BEAM

L6 THRU L10 AND L19 THRU L22

SCALE: 0 10'



FLOOR BEAM

L1 THRU L5, L11 THRU L18 AND L23 THRU L27

SCALE: 0 10'

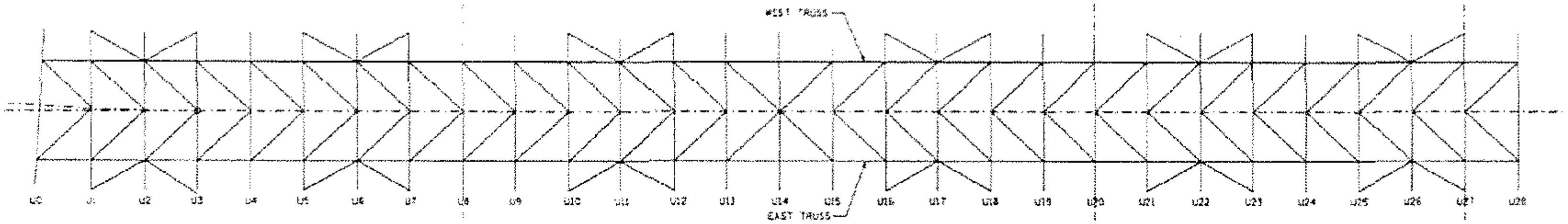
URS

SIGNATURE:
PRINTED NAME:
DATE: , 2003 REG. NO.

TITLE
FLOOR TRUSS KEY PLAN

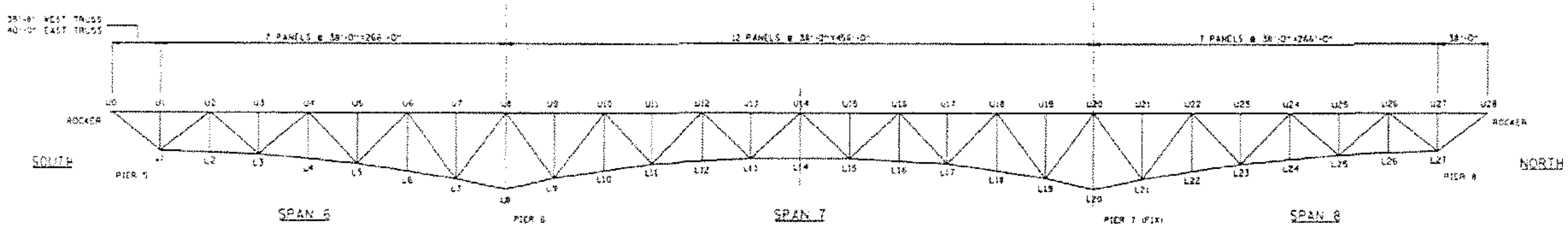
DES: DR: APPROVED:
CHK: CHK:
SHEET NO. OF SHEETS

BRIDGE NO.
9340



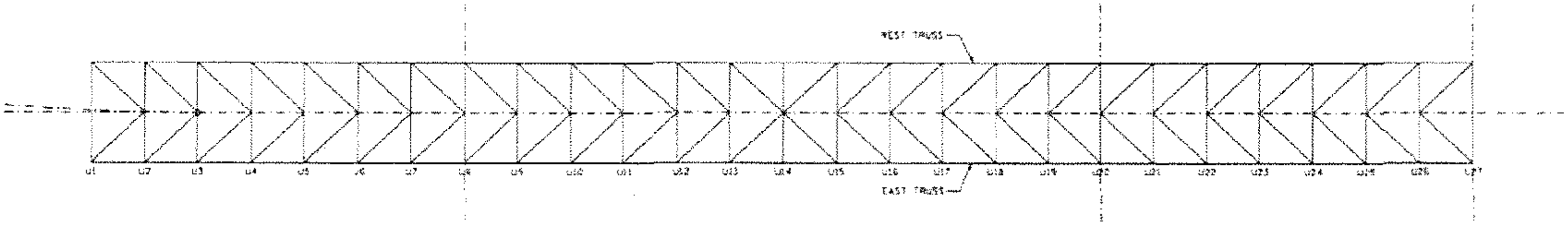
PLAN OF UPPER LATERALS

SCALE: 0 40'



ELEVATION OF TRUSS

SCALE: 0 40'



PLAN OF LOWER LATERALS

SCALE: 0 40'

URS	SIGNATURE: PRINTED NAME: DATE: , 2003 REG. NO.	TITLE: DECK TRUSS KEY PLAN	DES: DR: APPROVED: CHK: CHK: SHEET NO. OF SHEETS	BRIDGE NO. 9340

Mn/DOT Contract No.85907

CFMS No. A57100

STATE OF MINNESOTA
PROFESSIONAL AND TECHNICAL SERVICES CONTRACT

State Project Number (SP): 2783-9340 **Trunk Highway (TH):** 35W
Project Identification: Evaluation of Bridge Number 9340 (I-35W over Mississippi River)

This Contract is between the State of Minnesota acting through its Commissioner of Transportation (State) and URS, Incorporated. Address: 700 Third Street South, Minneapolis, MN 55415 (Contractor).

Recitals

1. Under Minnesota Statutes §15.061, the Commissioner of Transportation is empowered to engage such assistance as deemed necessary.
2. The State is in need of a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study will allow the State to develop a repair strategy for potential future repairs. .
3. The Contractor represents that it is duly qualified and agrees to perform all services described in this contract to the satisfaction of the State.

Contract Special Terms

Article 1 Term of Contract:

1.1	Effective date:	The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.
1.2	Expiration date:	January 1, 2006, or until all obligations have been approved, which ever occurs first.
1.3	Survival terms:	The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.
1.4	Exhibits:	Exhibits A through D are attached and incorporated into this Contract.

Article 2 Scope of Work:

2.1 The services to be provided for under this Contract by the Contractor are:
The project goal is to identify structural members of the truss-arch spans that are most susceptible to cracking, identify the most critical members, and evaluate how the bridge will perform if any one of those critical members were removed. The project will evaluate how dead and live loads are redistributed in the bridge when failure occurs in the critical members and if/how adjacent members will fail when the loads are redistributed. The project will identify repairs to critical members and identify a preferred deck replacement staging in the truss-arch spans. The analysis will concentrate on the truss-arch portion of the bridge.

See Exhibit A for additional information.

2.2 Deliverables are defined as the work product created or supplied by the Contractor pursuant to the terms of this Contract. The brief summary of the deliverables of this Contract are as follows:

Items	Date Due
Progress report one • Five hard copies, 8 ½" x 11" bond	July 1, 2004

Progress report two • Five hard copies, 8 ½" x 11" bond	**September 1, 2004**
Progress report three • Five hard copies, 8 ½" x 11" bond	**November 1, 2004**
Progress report four • Five hard copies, 8 ½" x 11" bond	**January 1, 2005**
Preliminary report and conceptual plans • Five hard copies draft preliminary report on 8 ½" x 11" bond • Five hard copies draft conceptual plans on 11" x 17" bond • One electronic file each draft preliminary report in Microsoft Word, and draft preliminary report of conceptual plans in Microstation.	**March 1, 2005**
Draft final report and draft final conceptual plans • Five hard copies draft final report on 8 ½" x 11" bond • Five hard copies draft final report of conceptual plans on 11" x 17" bond • One electronic file each draft final report in Microsoft Word, and draft final conceptual plans in Microstation.	**May 1, 2005**
Final report • Five certified hard copies final report on 8 ½" x 11" bond • Five certified hard copies final report of conceptual plans on 11" x 17" bond • One electronic file each final report in Microsoft Word, and final conceptual plans in Microstation.	**May 17, 2005**

See Exhibit A for the details on the deliverables to be provided by the Contractor.

2.3 The State's Project Manager has the authority to update and adjust all project schedules when necessary at progress meetings within the terms of the Contract.

Article 3 Items Provided and Completed by the State:

3.1 After authorizing the Contractor to begin work, the State will furnish any data or material in it's possession relating to the project that may be of use to the Contractor in performing the work.

3.2 All such data furnished to the Contractor, will remain the property of the State and will be promptly returned upon the State's request or upon the expiration or termination of this contract.

3.3 The Contractor will analyze all such data furnished by the State. If the Contractor finds any such data to be incorrect or incomplete, the Contractor will bring the facts to the attention of the State before proceeding with the part of the project affected. The State will investigate the matter, and if it finds that such data is incorrect or incomplete, it will promptly determine a method for furnishing corrected data. Delay in furnishing data will not be considered justification for an adjustment in compensation.

3.4 See Exhibit A for a detailed listing of responsibilities to be completed by the State.

Article 4 Consideration of Payment:

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	$179,743.52
2. Overhead:	$234,133.91
3. Fixed Fee:	$ 49,665.29
4. Direct Expenses:	$ 23,180.00
Total Contract Amount:	$486,722.72

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of **130.26%** of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B. Any other direct costs not listed in Exhibit B must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed **$486,722.72.**

Article 5 Terms of Payment:

5.1 The Contractor will use the format set forth in Exhibit C when submitting Invoices.

5.2 The Contractor will submit the monthly progress report set forth in Exhibit D showing the progress of work in work hours according to the tasks listed in Article 2 Scope of Work.

Article 6 Contractor's Authorized Agent and Project Team:

6.1 The Contractor's Authorized Agent will be:

Name: Donald J. Flemming, P.E.
Title: Project Manager
Address: Thresher Square
700 Third Street South
Minneapolis, MN 55415
Phone: (612) 370-0700

If the Contractor's Authorized Agent or Project Manager changes at any time during this Contract, the Contractor will be responsible to follow conditions laid out within Article 16 of the General Terms.

Article 7 State's Authorized Agent and Project Manager:

7.1 The State's Authorized Agent will be:

Name: Victor E. Crabbe, P.E.
Title: Contract Administrator
Address: Minnesota Department of Transportation
Bridge Office
3485 Hadley Avenue North

Oakdale Minnesota 55128-3307
Phone: (651) 747-2113

The State's Authorized Agent, or his/her successor, has the responsibility to monitor the Contractor's performance and the authority to accept the services provided under this contract. If the services are satisfactory, the State's Authorized Agent will certify acceptance on each invoice submitted for payment.

7.2 The State's Project Manager for this Contract will be:

Name: Scott Pierson, P.E.
Title: Project Manager
Address: Minnesota Department of Transportation
Bridge Office
3485 Hadley Avenue North
Oakdale Minnesota 55128-3307
Phone: (651) 747-2192

The State's Project Manager, or his/her successor, has the responsibility to monitor the Contractor's performance and progress, the Project Manager will sign progress reports, review billing statements, make recommendations to the State's Authorized Agent for acceptance of the Contractor's goods or services, and make recommendations to the State's Authorized Agent for certification for payment of each Invoice submitted for payment.

Article 8 Modification of the General Terms:

8.1 Delete Article 15.3 "Retainage" pursuant to Minnesota Statutes Sections 16C.08, subdivision 5, which states that retainage paragraph does not apply to contracts for professional services as defined in Minnesota Statutes Sections 326.02 to 326.15.

Article 9 Additional Provisions:

None.

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General Terms

Article 10 Term of Contract

10.1 This Contract will be effective upon the date set in the Special Terms and will remain in effect until the Expiration Date set in the Special Terms, or until all obligations set forth in this Contract have been fulfilled to the satisfaction of State, or until terminated under Article 31, whichever event occurs first.

10.2 For delays encountered that are beyond Contractor's control, and upon written request from Contractor, State's Authorized Agent may extend the Work Completion Date, as set forth in the Special Terms of this Contract. The length of such time extension will be determined by State's Authorized Agent and will not exceed the Expiration Date of Contract.

10.3 It will be Contractor's responsibility to notify State's Project Manager and State's Authorized Agent, in writing, if the project will not be completed as scheduled. State's Project Manager will have the authority to adjust the schedule, in writing, within the term of Contract.

Article 11 Governing Law, Jurisdiction, and Venue

11.1 This Contract will be interpreted pursuant to Minnesota law. Any citation to federal or state law incorporates the language of that law into this Contract as if fully set forth herein. Venue for all legal proceedings arising out of this Contract, or its breach, will be in the applicable state or federal court with competent jurisdiction in Ramsey County, Minnesota.

Article 12 Terms of General Terms

12.1 Any and all provisions of these General Terms will remain in force unless they are specifically modified, in writing, by the Special Terms of this Contract.

12.2 To the extent of any inconsistencies between the Special Terms and these General Terms, the Special Terms will control. Minnesota law supersedes any of the Special Terms or General Terms set forth in this Contract.

Article 13 Terms of Payment

13.1 Subject to the provisions of the Special and General Terms, all services performed and/or goods satisfactorily supplied by Contractor pursuant to this Contract will be paid by State. Compensation will be in accordance with the Special Terms, Article 4 Consideration of Payment.

13.2 If it appears at any time that Contractor will exceed the Total Contract Amount stated in the Special Terms of this Contract, Contractor must notify State's Authorized Agent in writing in a timely manner. Contractor will not be compensated for work performed in excess of the Total Contract Amount without a written, and fully executed, amendment to this Contract. Any work performed beyond that which is provided for in this Contract without a prior written amendment signed by State, will be deemed voluntary and Contractor will not be entitled to compensation for the extra work.

13.3 If Contractor claims any instructions, latent conditions, or conditions exist that cause extra cost under this Contract, Contractor must make a written notice for any extra cost incurred within 10 days after such instruction or observance of conditions. Latent conditions are conditions not anticipated by the Special Terms of this Contract. Any claims made without a written notice will be refused and no claim will be valid unless so made. Any work performed under an amendment to this Contract that has not been properly approved and executed by the parties will be performed at Contractor's own risk. State's Authorized Agent will have the sole authority to determine whether any claimed extra costs are reasonable under the circumstances and whether State will approve the extra costs.

13.4 State will not pay overtime rates for any overtime work or services performed by Contractor or a subcontractor unless State's Authorized Agent has specifically requested Contractor to do so in writing. When specifically authorized by State's Authorized Agent, overtime premium pay will be reimbursed as a direct cost for the overtime portion of the hourly rate and is not eligible for overhead costs or profit.

13.5 Reimbursement for travel and subsistence expenses actually and necessarily incurred by Contractor as a result of performance of this Contract will not exceed the amount defined in the Special Terms. Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations." Contractor will not be reimbursed for travel and subsistence expenses incurred outside the state of Minnesota unless it has received prior written approval from State for such out of state travel. The state of Minnesota will be considered the home base for determining whether travel is "out of state."

13.6 The final payment due Contractor will be based on actual acceptable costs as determined by an audit conducted by State. The audit will be conducted using the Cost Principles and Procedures set forth in the Federal Acquisition Regulations, 48 Code of Federal Regulations Section 31, or as modified by state policies and procedures. Based upon final audit, the final payment to Contractor may exceed the Total Contract Amount without amending this Contract.

Article 14 Procedure for Payment

14.1 Payments will be made by State within 30 days of Contractor's presentation of invoices and progress reports for services performed and the acceptance of such services by State's Authorized Agent as identified in Minnesota Statutes Section 16A.124.

14.2 Invoices for payment must be submitted by Contractor monthly to State's Authorized Agent in the form prescribed by State. Invoices must identify the cost for the services performed and/or goods delivered for the billing period and must satisfy the requirements listed below:

14.21 Each invoice must contain the following information: Mn/DOT Agreement Number, Mn/DOT contract invoice number (sequentially numbered), billing address if different from business address, and Contractor's original signature attesting that the invoiced services and costs are new and that no previous charge for those services and/or goods has been included in any prior invoice.

14.22 Direct nonsalary costs allocable to the work under this Contract, and defined in the Special Terms of this Contract, must be itemized and supported with invoices or billing documents to show that such costs are properly allocable to the work. Direct nonsalary costs are any costs that are not the salaried costs directly related to the work of Contractor. Supporting documentation must be provided in a manner that corresponds to each direct cost.

14.23. The original of each invoice and progress report must be sent to State's Authorized Agent for review and payment.

14.24 Contractor must provide, upon request of State's Authorized Agent, the following supporting documentation:

a. Direct salary costs of employees' time directly chargeable for the services performed under this Contract. This must include a payroll cost breakdown identifying the name of the employee, classification, actual rate of pay, hours worked, and total payment for each invoice period; and

b. Signed time sheets or payroll cost breakdown for each employee listing dates and hours worked. Computer generated printouts of labor costs for the project must contain the project number, each employee's name, hourly rate, regular and overtime hours, and the dollar amount charged to the project for each pay period.

14.3 If Contractor is authorized by State to use or uses any subcontractors, Contractor must include all the above supporting documentation in any subcontractor's contract, and Contractor must make timely payments to its subcontractors.

14.4 Contractor must require subcontractors' invoices to follow the same form and contain the same information as set forth in this Article 14.

Article 15 Conditions of Payment

15.1 All services and/or goods provided by Contractor pursuant to this Contract must be performed to the satisfaction of State, and in accordance with the following:

15.11 Applicable federal, state, and local laws, ordinances, rules, and regulations.
15.12 Applicable state standards, policies, and practices.

15.2 Contractor will not receive payment for work determined by State's Authorized Agent to be unsatisfactory, or performed in violation of federal, state, or local laws, ordinances, rules, or regulations.

15.3 Retainage: Pursuant to Minnesota Statutes Section 16C.08, subdivision 5(b), as enacted, no more than 90 percent of the compensation due under this Contract may be paid until the final product(s) of this Contract have been reviewed by the head of the Minnesota Department of Transportation ("Mn/DOT"). The balance due and owing will be paid at the time that the head of Mn/DOT determines that Contractor has satisfactorily fulfilled all the terms of this Contract.

15.4 All services and/or goods covered by progress payments made by State will become the sole property of State. This provision must not be construed as relieving Contractor from sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work or as waiving the right of State to require the fulfillment of all of the terms of this Contract.

15.5 Nothing in this Contract must be construed in any way to operate to relieve Contractor from its obligation to complete the services and/or deliver any goods described in this Contract for a sum not to exceed that set forth in the Special Terms.

Article 16 Contractor's Key Personnel

16.1 Contractor's key personnel specified by name and title in the Special Terms will be considered essential to the work being performed.

16.2 If, for any reason, substitution of a key person becomes necessary, Contractor must provide two weeks' advance written notification of the substitution to State's Authorized Agent. The written notification must include the proposed successor's name and a resume of his/her qualifications. State's Authorized Agent will have the right to reject the proposed successor based upon reasonable grounds.

Article 17 Assignment

17.1 Contractor may neither assign nor transfer any rights or obligations under this Contract without authorization from State's Authorized Agent and a fully executed assignment agreement. The written authority will in no way relieve Contractor from the primary responsibility for performance of the services and/or delivery of the goods specified in this Contract.

Article 18 Subcontracts

18.1 Contractor must require all subcontractor contracts to contain all appropriate terms and conditions of this Contract, including Articles 10, 11, 13, 14, 16, 18 through 34 and 36, as they apply to the sub contractor. The use of subcontractors does not relieve Contractor from performing and delivering the work stated in this Contract.

18.2 State's Authorized Agent must review, and accept for compliance with the General and Special Terms of this Contract, all subcontractor contracts exceeding $10,000.00 prior to the execution of any such subcontractor contract. State's Authorized Agent has the authority to reject any subcontractor contract that does not comply with the General and Special Terms of this Contract.

18.3 A copy of any and all subcontractor contracts must be sent to State's Authorized Agent after execution of the subcontractor contract and prior to work starting under the subcontractor contract.

Article 19 Amendments, Change Orders, Merger, and Waiver

19.1 Amendments to this Contract will be considered only for unforeseen work or services that were excluded in the Scope of Work of the Special Terms and that are considered essential to the work. Any written claim made by Contractor for extra work or costs under this Contract that has been approved by State's Authorized Agent must be evidenced by an amendment to this Contract. Amendments must be in writing and executed and approved by the same parties and officials who executed and approved the original Contract, or their successors in office. Contractor must notify State's Project Manager in writing if Contractor will be delayed in any way from completing the project under this Contract.

19.2 The work to be done in connection with this Contract may be changed at the request of State, with the mutual concurrence of Contractor. Any change will be clearly and fully defined in writing, and approved by both parties. Change orders must be consistent with the basic purpose of this Contract and within the general Scope of Work identified in the Special Terms. Changes in the Total Contract Amount or Contract Expiration Date are not permitted in a change order.

19.3 This Contract, including all incorporated items, contains all negotiations and agreements between Contractor and State. No other understanding, whether written or oral, regarding this Contract, may be used to bind either party.

19.4 Failure of a party to enforce any provision of this Contract will not constitute, or be construed as, a waiver of such provision or of the right to enforce such provision.

Article 20 Affirmative Action

20.1 For contracts in excess of $100,000.00, Contractor certifies that it is in compliance with Minnesota Statutes Section 363.073.

20.2 Contractor certifies that it is an equal opportunity employer and complies with Title VI of the Civil Rights Act of 1964, and the President's Executive Order Number 11246 as amended by Executive Order Number 11375. Accordingly, 49 Code of Federal Regulations Section 21 through Appendix C and 23 Code of Federal Regulations Section Part 200 will be applicable.

20.3 If Contractor has more than 40 full-time employees within the State of Minnesota on a single working day during the previous twelve months Contractor must comply with the following Affirmative Action requirements for disabled workers:

20.31 Contractor must not discriminate against any employee or applicant for employment because of physical or mental disability in regard to any position for which the employee or applicant for employment is qualified. Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified disabled persons without discrimination based upon their physical or mental disability in all employment practices such as the following: Employment, upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

20.32 Contractor will comply with the rules and relevant orders of the Minnesota Department of Human Rights issued pursuant to the Minnesota Human Rights Act.

20.33 In the event of Contractor's noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance may be taken in accordance with Minnesota Statutes Section 363.073, and the rules of relevant orders of the Minnesota Department of Human Rights issued pursuant to the Minnesota Human Rights Act.

20.34 Contractor will post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the commissioner of the Minnesota Department of Human Rights. Such notices must state Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled employees and applicants for employment, and the rights of applicants and employees.

20.35 Contractor must notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that Contractor is bound by the terms of Minnesota Statutes Section 363.073, or the Minnesota Human Rights Act and is committed to take affirmative action to employ and advance in employment physically and mentally disabled persons.

Article 21 Compliance with Licenses, Permits, and Other Regulations

21.1. Contractor must procure all licenses, permits, or other rights necessary to fulfill its obligations under this Contract in compliance with all applicable federal and state laws.

Article 22 Audits and Inspections

22.1 The books, records, documents, and accounting procedures and practices of Contractor relevant to this Contract are subject to examination by the State, Minnesota Department of Transportation, and/or Legislative Auditors, as appropriate, for a minimum of six years from the end of the project.

22.2 Duly authorized representatives of State (and the Federal Highway Administration, if federal funds are involved) have the right to inspect the work of Contractor under this Contract, during regular working hours, whenever it is deemed necessary to do so.

22.3 Work Effort Audits:

22.31 State may conduct work effort audits for the various work tasks described in the Special Terms. Audits will be randomly selected for completed work tasks. Audits will include work effort reviews and effort level analysis to determine the reasonableness of the hours charged.

22.32 Contractor must maintain work effort progress reports showing work tasks, hours worked on the task by the various personnel assigned to this work, and work effort performed by subcontractors assigned to the tasks. The progress report must be in the format as described in the Special Terms of this Contract.

Article 23 Government Data Practices and Intellectual Property

23.1 Government Data Practices. Contractor and State must comply with the Minnesota Government Data Practices Act, Minnesota Statutes Chapter13, as it applies to all data provided by State under this contract, and as it applies to all data created, collected, received, stored, used, maintained, or disseminated by Contractor under this contract. The civil remedies of Minnesota Statutes Section 13.08 apply to the release of the data referred to in this clause by either Contractor or the State.

If Contractor receives a request to release the data referred to in this Clause, Contractor must immediately notify State. State will give Contractor instructions concerning the release of the data to the requesting party before the data is released.

23.2. Intellectual Property Rights.

23.21 *Intellectual Property Rights of State.* State owns all rights, title, and interest in all of the intellectual property rights, including copyrights, patents, trade secrets, trademarks, and service marks in the Works and Documents *created and paid for under this contract.* Works means all inventions, improvements, discoveries (whether or not patentable), databases, computer programs, reports, notes, studies, photographs, negatives, designs, drawings, specifications, materials, tapes, and disks conceived, reduced to practice, created or originated by Contractor, its employees, agents, and subcontractors, either individually or jointly with others in the performance of this contract. Works includes "Documents." Documents are the originals of any databases, computer programs, reports, notes, studies, photographs, negatives, designs, drawings, specifications, materials, tapes, disks, or other materials, whether in tangible or electronic forms, prepared by Contractor, its employees, agents, or subcontractors, in the performance of this contract. The Documents will be the exclusive property of State and all such Documents must be immediately returned to State by Contractor upon completion or cancellation of this contract. To the extent possible, those Works eligible for copyright protection under the United States Copyright Act will be deemed to be "works made for hire." Contractor assigns all right, title, and interest it may have in the Works and the Documents to State. Contractor must, at the request of State, execute all papers and perform all other acts necessary to transfer or record State's ownership interest in the Works and Documents.

23.22 *Intellectual Property of Contractor.* Contractor retains title and interest in all of its standard details, plans, specifications, and engineering computation documents, ("Previously Created Works and Documents") whether in written or electronic form, which have been incorporated into the Works and Documents, but which were developed by Contractor independent of this contract. Contractor issues to State a royalty-free, nonexclusive, and irrevocable license to use the Previously Created Works and Documents.

23.23 *Notification.* Whenever contractor reasonably believes it, or its employees or subcontractors, has made an invention, improvement, or discovery (whether or not patentable) in the performance of this contract, and has or actually or constructively reduced it to practice Contractor will immediately give State's Authorized Representative written notice thereof, and must promptly furnish the Authorized Representative with complete information and/or disclosure thereon.

23.24 *Representation.* Contractor must perform all acts, and take all steps necessary to ensure that all intellectual property rights in the Works and Documents are the sole property of State, and that neither Contractor nor its employees, agents, or subcontractors retain any interest in and to the Works and Documents. Contractor represents and warrants that the Works and Documents do not and will not infringe upon any intellectual property rights of other persons or entities. Contractor will indemnify; defend, to the extent permitted by the Attorney General; and hold harmless State, at Contractor's expense, from any action or claim brought against State to the extent that it is based on a claim that all or part of the Works or Documents infringe upon the intellectual property rights of others. Contractor will be responsible for payment of any and all such claims, demands, obligations, liabilities, costs, and damages, including but not limited to, attorney fees. If such a claim or action arises, or in Contractor's or State's opinion is likely to arise, Contractor must, at State's discretion, either procure for State the right or license to use the intellectual property rights at issue or replace or modify the allegedly infringing Works or Documents as necessary and appropriate to obviate the infringement claim.

This remedy of State will be in addition to and not exclusive of other remedies provided by law.

23.25 *State's Reuse of Works and Documents.* If the Works and Documents created and paid for under this contract are engineering plans and specifications requiring the certification of a licensed professional engineer, State acknowledges that such plans and specifications have been created solely for the specific project covered by this contract and may not be suitable for reuse on other projects. Government Data Practices. The Minnesota Government Data Practices Act, Minnesota Statutes Chapter13, applies to this contract and all work performed under it. The act provides, inter alia, disclosure and non-disclosure requirements for all data provided to or by the State and civil remedies for failure to comply with the act.

23.3 The originals of reports, drawings, work sheets, plans, field notes, computations, and other project data must be relinquished to State:

23.31 Upon written notice of completion or termination of this Contract, or
23.32 Upon written notification by State, or
23.33 Upon final payment by State to Contractor for this Contract.

Article 24 Liability

24.1 Contractor must indemnify, save, and hold State, its agents, and employees harmless from any and all claims or causes of action, including attorney's fees incurred by State, arising from a negligent or otherwise wrongful act, or omission in the performance of this Contract by Contractor or Contractor's agents or employees. This clause will not be construed to bar any legal remedies Contractor may have for State's failure to fulfill its obligations pursuant to this Contract.

Article 25 Workers' Compensation

25.1 Any and all employees of Contractor, including its subcontractors, or other persons while engaged in the performance of any work or services required by Contractor under this Contract, will not be considered employees of State. Any and all claims that may arise under the Workers' Compensation Act of Minnesota on behalf of said employees, or other 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 Contractor's employees, or other person while so engaged on any of the work or services to be rendered, will in no way be the obligation or responsibility of State. Pursuant to Minnesota Statutes Section 176.182, acceptable evidence of compliance with Workers' Compensation insurance coverage requirements must be presented to State before State may enter into a contract with Contractor.

Article 26 Insurance

26.1 A certificate of insurance for each type of insurance required under this Contract must be filed with State's Authorized Agent within 30 days of execution of this Contract and prior to commencement of any work under this Contract. Each policy must contain a 30 day notice of cancellation, nonrenewal, or material change to all named and additional insured.

26.2 Contractor must maintain and furnish satisfactory evidence of the following insurance policies:

26.21 Loss by any means, of all data furnished to Contractor by State, and for partially completed data for which State has made payment.

26.22 **Workers' Compensation Insurance:** Contractor will provide Workers' Compensation insurance for all Contractor employees and, in case any work is subcontracted, Contractor will require the subcontractor to provide Workers' Compensation insurance in accordance with the statutory requirements of state of Minnesota, including Coverage B, Employer's Liability, at limits not less than $100,000.00 bodily injury by disease per employee; $500,000.00 bodily injury by disease aggregate; and $100,000.00 bodily injury by accident. Evidence of subcontractor's insurance must be filed with Contractor.

26.23 **Commercial General Liability:** Contractor will maintain insurance protecting Contractor from claims for damages for bodily injury, including sickness or disease, death, and for care and loss of services as well as from claims for property damage including loss of use which may arise from operations under this Contract whether such operations be by Contractor or by a subcontractor or by anyone directly or indirectly employed under this Contract. Unless otherwise specified within this Contract, Contractor's insurance minimum amounts will be as follows:

$1,000,000.00 - per occurrence
$2,000,000.00 - annual aggregate

In addition, the following coverages should be included:

Bodily Injury and Property Damage
Products and Completed Operations Liability
Blanket Contractual Liability
Name State as an Additional Insured

26.24 **Commercial Automobile Liability:** Contractor will maintain insurance protecting Contractor from claims for damages for bodily injury, including sickness or disease, death, and for care and loss of services, as well as from claims for property damage including loss of use which may arise from operations under this Contract whether such operations were by Contractor or by subcontractor or by anyone directly or indirectly employed under this Contract. Unless otherwise specified within this Contract, Contractor insurance minimum amounts will be as follows:

$1,000,000.00 - per occurrence Combined Single limit for Bodily Injury and Property Damage.

In addition, the following coverages should be included:

Owned, Hired, and Non-owned
Name State as an Additional Insured

26.25 **Professional/Technical, Errors and Omissions, and/or Miscellaneous Liability Insurance:** Unless otherwise specified within this Contract, Contractor insurance minimum amounts will be as follows:

$1,000,000.00 - per claim
$2,000,000.00 - annual aggregate

On request, Contractor must submit a financial statement signed by a Certified Public Accountant which provides evidence that Contractor has adequate assets to cover any deductible which applies to this policy.

This policy will provide coverage for all claims Contractor will become legally obligated to pay resulting from any actual or alleged negligent act, error, or omission related to Contractor's professional services required under this Contract.

26.26 For work on railroad property, Contractor must obtain Railroad Protective Liability Insurance in accordance with Mn/DOT Specification 1708.2 (2000 Edition) or any subsequent changes or modifications to this specification.

26.3 Contractor must:

26.31 Include legal defense fees in addition to its liability policy limits, with the exception of 26.25 above; and

26.32 Obtain insurance policies from an insurance company having an "AM BEST" rating of AVI or better.

26.4 State reserves the right to immediately rescind this Contract if Contractor is not in compliance with the insurance requirements and retains all rights to pursue any legal remedies against Contractor. All insurance policies must be open to inspection by State, and copies of policies must be submitted to State's Authorized Agent upon written request.

Article 27 Deliverable Standards

27.1 State will have the authority to disapprove or reject services and/or goods that are defective. Contractor will be responsible for the accuracy of its work under this Contract and must make immediate, necessary revisions, repairs, or corrections without compensation resulting from errors and omissions on the part of Contractor.

Services and/or goods delivered under this Contract must be in accordance with applicable federal or state standards and/or specifications and must be of a quality that is satisfactory to State. Acceptance of the services and/or goods by State will not be considered a waiver of any provision of this Contract and will not relieve Contractor of the responsibility for subsequent correction of any such errors or omissions and the clarification of any ambiguities.

In the event revisions, repairs, or corrections to the deliverables must be made, Contractor must invoice State for any employee's time necessary to revise, repair, or correct errors or omissions at a rate of zero dollars per hour for the number of hours necessary to perform the work.

27.2 The services and/or goods provided to State by Contractor must be of such quality that they are suitable for their intended purpose which meets the design requirements provided for in the Special Terms.

27.3 Time is of the essence with respect to this Contract. In the event Contractor fails to perform its duties by the time fixed for the completion of the work, State may elect to immediately terminate this Contract.

27.4 Neither party will be held responsible for delay or failure to perform when such delay or failure is due to any of the following, unless the act or occurrence could have been reasonably foreseen and reasonable action could have been taken to prevent the delay or failure: fire, flood, epidemic, strikes, wars, acts of God, unusually severe weather, or delays or defaults caused by public carriers, provided the defaulting party gives written notice as soon as possible to the other party of its inability to perform.

Article 28 Printing, Paper Stock, and Ink Requirements

28.1 If this Contract results in reports or documents paid for by State, Contractor must comply with Minnesota Statutes Sections 16B.121 and 16B.122, for the purchase of printing, paper stock, and printing ink.

Article 29 Publicity and Endorsements

29.1 Any publicity given to the program, publications, or services provided resulting from this Contract, including, but not limited to, notices, informational pamphlets, press releases, research, reports, signs, and similar public notices prepared by or for Contractor or its employees individually or jointly with others, or any subcontractors must identify State as the sponsoring agency and must not be released without prior approval by the Commissioner of Transportation, unless such release is a specific part of an approved work plan included in this Contract.

29.2 Contractor must not claim that State endorses its products or services.

Article 30 Officials not to Benefit

30.1 Without prior written consent of State, Contractor must not employ any professional or technical personnel to provide services under this agreement who are or have been at any time during the time period of this Contract in the employ of State, except retired State employees, without written consent from State.

30.2 Contractor warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for Contractor, to solicit or secure this Contract, and that Contractor has not paid or agreed to pay any company or person, other than a bona fide employee working for Contractor, any fee, commissions, percentage, brokerage fee, gifts, or any other consideration, contingent upon or resulting from the award of making of this Contract.

Article 31 Termination

31.1 This Contract may be immediately terminated by State or the Commissioner of Administration, at any time, with or without cause, upon written notice to Contractor. In the event of such termination Contractor will be entitled to payment, determined on a pro rata basis, for services and/or goods satisfactorily performed or delivered.

31.2 In the event State cannot or does not obtain funding from the Minnesota Legislature, or funding cannot be continued at a level sufficient to allow for the purchasing of the services and/or goods contained herein, this Contract may be immediately terminated, at State's option, by written notice of termination delivered in person, by mail, or facsimile to Contractor at the address specified in this Contract. State will not be obligated to pay for any services and/or goods provided by Contractor after such notice of termination.

Article 32 Errors and Omissions

32.1 Contractor will be responsible for the accuracy of the work and must promptly make necessary revisions or corrections resulting from Contractor's errors, omissions, or negligent acts without additional compensation. Acceptance of the work by State will not relieve Contractor of the responsibility for subsequent correction of any errors or omissions or for clarification of any ambiguities.

It is understood by the parties that State will rely on the professional performance and ability of Contractor. Any examination by State or the Federal Highway Administration, or any acceptance or use of the work product of Contractor, will not be considered to be a full and comprehensive examination and will not be considered an approval of the work product of Contractor which would relieve Contractor from any liability or expense that could be connected with Contractor's sole responsibility for the propriety and integrity of the professional work to be accomplished by Contractor pursuant to this Contract.

32.2 At any time during construction or any phase of work performed by others based on data provided by Contractor, Contractor must confer with State when necessary for the purpose of interpreting the information secured and/or to correct any errors or omissions made by Contractor. Contractor must prepare any and all plans or data needed to correct the errors or omissions without added compensation, even though final payment may already have been received by Contractor. Contractor must give immediate attention to these changes so there will be minimal delay to the construction or other work as referenced.

32.3 If errors, omissions, or negligent acts are made by Contractor in any phase of the work, the correction of which may require additional field or office work, Contractor will be promptly notified by State and will be required to perform such additional work as may be necessary to correct these errors, omissions, or negligent acts without undue delay and without additional cost to State. If Contractor is aware of any errors, omissions, or negligent acts made in any phase of the work, the corrections of which may require any additional field or office work, Contractor must promptly perform such additional work as may be necessary to correct these errors, omissions, or negligent acts without undue delay and without additional cost to State.

32.4 Contractor will be responsible for any damages incurred as a result of its errors, omissions, or negligent acts and for any loss or cost to repair or remedy Contractor's errors, omissions or negligent acts. Acceptance of the work by State will not relieve Contractor of the responsibility for subsequent correction of any such errors, omissions, or negligent acts, or of liability for loss or damage resulting therefrom.

32.5 Contractor must respond to State's notice of any errors or omissions within 24 hours and give immediate attention to these corrections to minimize any delays to State. Notification will be by telephone, followed by Certified Mail. Contractor may be required to make a field review of the project site, as defined in the Special Terms, if directed by State's Authorized Agent and Contractor may be required to send personnel to the appropriate State district office as part of correcting any errors or omissions.

Article 33 Quality Assurance and Quality Control

33.1 Prior to approval and execution of this Contract, Contractor must have a Quality Assurance and Quality Control (QA/QC) Program. During the term of this Contract, Contractor must adhere to Contractor's QA/QC Plan, which was prepared by Contractor and accepted by State's Authorized Agent, for this Contract. Contractor's QA/QC Plan is incorporated into this Contract by reference. With each deliverable submitted to State pursuant to this Contract, Contractor must certify in writing to State's Authorized Agent that there was compliance with the QA/QC Plan. State may cancel this Contract for Contractor's failure to follow the QA/QC Plan for this Contract.

Article 34 Disputes

34.1 State's Authorized Agent will be the initial interpreter of the requirements of this Contract and will judge the acceptability of the work hereunder. Claims, disputes, and other matters relating to the acceptability of the work will be referred in writing to State's Authorized Agent, with a request for a formal decision to be rendered in writing within a reasonable time. Written notice of each such claim, dispute, or other matter must be delivered by Contractor to State's Authorized Agent within 15 working days of the occurrence of the event giving rise to the claim, dispute, or other matter. Written supporting data must be submitted to State's Authorized Agent within 45 days of each such occurrence, unless State's Authorized Agent allows an additional period of time to ascertain more accurate data.

The rendering of a decision by State's Authorized Agent will be a condition precedent to Contractor's exercise of such rights and remedies as it may have under this Contract or at law in respect to any claim, dispute, or other matter.

Article 35 Federal Clauses

If Federal Funds are involved with this Contract, the following additional conditions apply:

35.1 Federal reimbursement will be limited to the Federal share of costs which are allowable under the Federal cost principles contained in the Federal Acquisition Regulation, Contract Cost Principles and Procedures, 48 Code of Federal Regulations Section 31.

35.2 Contractor warrants and represents that State and the Federal Highway Administration will have a royalty-free, nonexclusive, and irrevocable license to reproduce, publish, or otherwise use for federal, state, or local government purposes, any patentable subject matter or copyrightable materials developed, or any rights of copyright to which State has purchased ownership, under this Contract.

When applicable, the patent rights provisions of 48 Code of Federal Regulations Section 27 will apply to this Contract regarding rights to inventions. Such provisions are incorporated by reference and must be incorporated in all subcontracts by reference.

35.3 Federal-Aid Contracts: Contractor acknowledges that by signing this Contract, it certifies to the best of its knowledge and belief:

35.31 That no Federal appropriated funds have been paid or will be paid, by or on behalf of Contractor, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract or the making, extension, continuation, renewal, amendment, or modification of any Federal grant, loan, or cooperative agreement.

35.32 That if any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, Contractor must complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

35.33 That this certification is a material representation of fact upon which reliance was placed when this transaction was made or entered. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 United States Code Section 1352. Any person who fails to file the required certification will be subject to a civil penalty.

35.34 That it must require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000.00 and that all such subcontractors must certify and disclose accordingly.

35.4 Contractor must comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act, 42 United States Code Section 7606; Section 508 of the Clean Water Act, 33 United States Code Section 1368; Executive Order Number 11738, and all applicable regulations promulgated by the United States Environmental Protection Agency.

Article 36 Data Disclosure

36.1 Contractor consents to disclosure of its social security number, federal employer tax identification number, and/or Minnesota tax identification number to federal and state tax agencies and state personnel involved in the payment of state obligations. These identification numbers may be used in the enforcement of federal and state tax laws which could result in action requiring Contractor to file state tax returns and pay delinquent state tax liabilities, if any. Minnesota Statutes Section 270.66.

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STATE ENCUMBRANCE VERIFICATION

Individual certifies that funds have been encumbered as required by Minn. Stat. §§ 16A.15 and 16C.05.

Signed:

Date: 12·22·2003

CFMS Contract No. A- 57100

CONTRACTOR

The Contractor certifies that the appropriate person(s) have executed the contract on behalf of the Contractor as required by applicable articles, bylaws, resolutions, or ordinances.

By:

Title: V.P.

Date: 12-19-03

By:

Title: V.P.

Date: 12/19/03

STATE AGENCY

By: ORIGINAL SIGNED BY
(with delegated authority)
Richard Stehr

Title: Division Director

Date: 12/22/03

COMMISSIONER OF ADMINISTRATION

By:

Date: 12-23-03

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

SECTION 1. INTRODUCTION

Bridge 9340 is a major fracture critical structure that has experienced some stress cracking of its truss-arch. The bridge spans the Mississippi River in Minneapolis and carriers major Interstate 35W traffic through the city.

In this Contract, the Contractor will perform an evaluation of the bridge truss-arch spans to evaluate its various components to determine their structural integrity. The study will identify the most critical structural members susceptible to cracking, determine how the bridge will perform under critical member failure conditions, determine how the critical members will fail (crack), and develop a retrofit repair scheme for each member.

Report generated from this study will be utilized by the State as the reference for development of future renovation work to be done on the bridge.

SECTION 2. WORK DESCRIPTION

ACRONYMS

AASHTO -- American Association of State Highway and Transportation Officials
DL – Dead Load
FEM -- Fixed End Moments
I – Impact
LL – Live Load
LRFD -- Load and Resistance Factor Design
T – Temperature
3-D – Three dimensional

KEY WORKS TO BE DONE IN THIS CONTRACT ARE:

1. Evaluate performance of expansion bearings and joints through visually monitoring and recording the movements of specifically made marks at different temperatures.
2. Develop a 3-D computer model that can reasonably predict truss member forces for dead, live, and temperature loads.
3. Fatigue evaluation of critical fatigue details on truss members
4. Identification of fracture critical members through evaluation of structural consequences for the loss of a tension member
5. Prepare plans for contingency repairs of eight most critical members.
6. Develop schemes of altering bridge floor system for improving structural redundancy and minimizing tensile stresses in truss members.
7. Develop a sequence of deck removal, structural changes and deck replacement for structural improvement.

SECTION 3. DETAILED PROJECT TASKS

Tasks are not necessaryly in sequense and some may be concurrent.

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

Task 1 - Data Collection and Tabulation

1.1 Collect and record bridge inventory data from plans, shop drawings material records, soil and foundation records, etc.

1.2 Collect and record bridge condition data from inspection reports, traffic data, etc.

1.3 Collect and sort strain measurement data from University of Minnesota reports and full original data in various formats:

1.4 Tabulate composition, attachment details and conditions for all primary and secondary members and connections.

Task 2 - Condition Inspection of Critical Truss Elements and Bearings

2.1 Inspect critical members, connections and fatigue details based on review of available data.

2.2 Inspect expansion bearings and joints and mark bearings and joints for monitoring movements with temperature changes.

2.3 Monitor and record bearing and joint marks for movement at a minimum of four (4) different seasonal temperatures. These will be compared to two observations undertaken in previous contracts.

2.4 Determine bearing and joints conditions and movement-temperature relationships based on monitoring records.

Task 3 - Development of 3-D Finite Element Model for Truss Spans

A 3-dimensional finite element model of the truss-arch spans will be developed using the GTSTRUDL analysis software.

3.1 Establish joint coordinates of beam members for trusses, braces, floorbeams and stringers and of plate elements for the deck.

3.2 Calculate and specify section properties for all beam members and plate elements of superstructure.

3.3 Determine point of fixity of pile foundation, or support stiffness, of four piers in truss spans.

3.4 Calculate and specify beam member section properties of all pier column and supporting piles.

3.5 Determine point of fixity of pile foundation, or support stiffness, of piers in approach spans.

3.6 Determine superstructure stiffness of approach spans.

3.7 Determine support type and stiffness at expansion joints between the truss and approach spans.

Task 4 - Execution and Calibration of Computer Model

4.1 Calibrate model for Live Load (LL) cases using strain measurements from University of Minnesota test data and adjust as necessary.

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

4.2 Perform stiffness analysis for DL and T changes using four cases of support conditions: (1) as-designed support conditions for truss and approach spans, (2) all supports fixed in truss spans and elastic connections to approach spans, (3) all supports fixed in truss spans and as-designed supports to approach spans, and (4) as-designed supports in truss spans and elastic connections to approach spans.

4.3 Perform stiffness analysis for AASHTO fatigue Live Load and Impact (LL+I) in each lane for four cases of support conditions.

4.4 Perform stiffness analysis for five vehicles identified by the State in each lane for four cases of support conditions.

4.5 Develop a database for automatic processing of Fixed End Moments (FEM) output for member forces and joint displacements.

Task 5 - Maximum Forces and Strength Ratings of Truss Members

5.1 Determine maximum LL+I tension and compression forces for all members for single and multi-lane loads from database

5.2 Determine maximum tension and compression member forces due to temperature load from database considering the four support conditions.

5.3 Compute tension and compression strengths of all primary and secondary truss members and store results in database.

5.4 Evaluate effects of secondary bending in truss members at joints and store in database.

5.5 Provide strength ratings per AASHTO LRFD load groups from database considering the four cases of support conditions.

Task 6 - Tabulation of Tension Members with Fatigue Details and Stresses

6.1 Identify and tabulate members in tension under total load Dead Load, Live Load, Impact and Temperature (DL+LL+I+T) from the database.

6.2 Categorize and tabulate fatigue details per AASHTO for all tension members in database.

6.3 Tabulate nominal LL+I stress range for fatigue details on all tension members using AASHTO fatigue truck from Guide Specifications and five State loads.

6.4 Adjust stress ranges at fatigue details due to secondary bending, section loss, etc.

6.5 Tabulate maximum total tensile stress due to DL+LL+I+T for fracture for the four cases of support conditions.

Task 7 - Remaining Fatigue Lives for Tension Truss Members

7.1 Utilize fatigue strength stress range equations for all tension members in database to determine fatigue life.

7.2 Evaluate effective stress ranges per University of Minnesota measured stress range histograms for instrumented members.

7.3 Estimate and extrapolate between the effective stress range and the maximum stress range for the remaining tension members from University of Minnesota test data and calibrated model.

7.4 Adjust loading stress ranges for local effects due to secondary bending, corrosion, etc.

7.5 Select eight most critical members in coordination with the State's Bridge Office.

7.6 Adjust loading stress ranges assuming a 10% section loss for eight most fatigue prone members.

7.7 Compute and tabulate remaining fatigue lives for all tension members per the AASHTO LRFD and Fatigue Guide Specifications.

7.8 Compute and tabulate remaining fatigue life and probability of fatigue cracking for all members per stress range curves.

Task 8 - Identificaton of Fracture Critical Members

8.1 Develop tension and compression failure criteria for truss members and connections based on ultimate failure state as originally designed.

8.2 Compute tension and compression failure forces for all primary and secondary truss members and connections and store in database.

8.3 Remove one tension member in the model and check all members against failure criteria under DL+LL+I.

8.4 Meet with the State and reach consensus on the approach for the remaining evaluation work.

8.5 Repeat the process for all tension members in database.

8.6 Tabulate all fracture critical members in order of fatigue and fracture failure probability.

Task 9 - Repair plans for Eight Fracture Critical Members

9.1 Design and prepare conceptual plans for contingency repair of the eight members selected in Task 7.5.

Task 10 - Concepts for Improving Structural Redundancy and Minimizing Truss Tensile Stresses

10.1 Develop concepts for adding structural redunancy such as altering the floor system by making it continuous and composite with trusses, adding post tensioning bars to individual members and hold-down system to bearings, etc.

10.2 Meet with the State to reach consensus on which concepts to evaluate with the computer model.

10.3 Evaluate improvement in structural redunancy for up to two concepts using the computer model by assessing the structural consequences of removing a critical member at a time.

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

10.4 Evaluate improvement in truss member fatigue stresses for up to two concepts using the computer model and assessing the live load stresses.

Task 11 - Conceptual Plans for Deck Removal, Structural Changes and Deck Replacement

11.1 Develop multiple staging and sequencing alternatives for deck removal and replacement in truss spans. The traffic staging alternatives will accommodate 2 lanes of traffic in each direction and be compatible with approach span constraints.

11.2 Analyze critical stresses at various stages of deck removal and replacement for applicable loads.

11.3 Study construction methods including the use of lightweight concrete.

11.4 Compare and evaluate alternatives to determine the best solution considering cost and member stresses.

11.5 Prepare conceptual plans for a procedure of deck removal, structural changes and deck replacement.

Task 12 - Final Report of Findings

12.1 Prepare condensed tables and figures for report, certified by a Registered Professional Engineer in the State of Minnesota.

12.2 Write report certified by a Registered Professional Engineer in the State of Minnesota.

12.3 Perform QA/QC review and revise as necessary.

12.4 Submit to State for review and comments

12.5 Revise the report per the State's comments. A Registered Professional Engineer in the State of Minnesota must certify report.

Task 13 Meetings with the State's Bridge Office

Six project progress meetings are assumed. These meetings are associated with the four Progress Reports, the Preliminary Report and Conceptual Plans, and the Final Draft and Conceptual Plans itemized under Section 4 Detailed Deliverables. Meetings will be scheduled approximately two weeks after delivery of each report

SECTION 4. DETAILED DELIVERABLES

A. Progress reports, Preliminary Report and Conceptual Plans, Draft Final Report and Final Report will be submitted to the State as outlined in Article 2.2 in the Contract Special Terms.

B. Six progress meetings will be arranged during the course of the contract. After submission of each progress report, a meeting will be scheduled between the State and the Contractor to discuss the progress report and progress of the project to date. The Contractor will:

- Take minutes during the meetings

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

- Produce concise written documentations of conversations resulting in key decisions.

C. Progress reports, preliminary report and final report will cover the following:

1. Progress report one	• Results of 3D computer model • Bearing measurements and effects of bearing conditions to member stresses • Strength ratings • Findings on evaluation of remaining fatigue lives
2. Progress report two	• Identification of fracture critical members • Selection of eight members for design of contingency repairs
3. Progress report three	• Concepts for improving structural redundancy • Minimizing fatigue stresses
4. Progress report four	• Concepts for deck replacement • Procedure for deck removal • Structural changes • Placement of new deck.
5. Preliminary report and conceptual plans	• Preliminary report and conceptual plans
6. Draft final report and draft final conceptual plans	• Results and findings regarding the remaining fatigue life and fracture critical condition of the structure, • Recommendations for structural improvement for redundancy and fatigue stresses. • The conceptual plans will include contingency repair of the eight members selected in Task 7.5. • A sequence of deck removal, structural changes, and deck replacement.
7. Final certified report	• Incorporate all key decisions taken during meetings • Must be certified by an engineer registered with the State of Minnesota.

SECTION 5. ITEMS PROVIDED BY THE STATE

1. Participation at the project coordination meetings and during the course of the contract.
2. Access to the bridge with an under bridge inspection vehicle for one inspection of the truss.
3. Information from the previous study of Bridge No. 9340 by the University of Minnesota.
4. Information needed for the study including plans, shop drawings, material records, soil and foundation records, etc. for Bridge No. 9340.

SECTION 6. DESIGN STANDARDS

The following design standards will be utilized in the study.

EXHIBIT A
SCOPE OF WORK AND DELIVERABLES

1. AASHTO LRFD Bridge Design Specifications
2. AASHTO Guide Specification for Fatigue Evaluation of Existing Steel Bridges
3. AASHTO Manual for Condition Evaluation of Bridges

THE BALANCE OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

EXHIBIT B
BUDGET TABLE

Engineering Task	Hours					
	Project Manager	Project Engineer	Design Engineer	CADD Tech.	QC Reviewer	TOTAL
TASK 1 DATA COLLECTION AND TABULATION						
Collect/record bridge inventory data	3	6	24			33
Collect/record bridge condition data	3	6	24			33
Collect/sort strain measurement data	4	20	40			64
Tabulate information for all primary and secondary members & connections	4	24	64			92
Sub-Total Item 1.	14	56	152	0	0	222
TASK 2 CONDITION INSPECTION OF CRITICAL TRUSS ELEMENTS AND BEARINGS						
Inspect critical members and connections	2	8	8			18
Inspect expansion bearings and joints	4	8	24			36
Monitor and record bearing and joints marks	4	8	24			36
Determine bearing and joints movement-temperature relationships	6	16	60		2	84
Sub-Total Item 2.	16	40	116	0	2	174
TASK 3 DEVELOPMENT OF 3-D FINITE ELEMENT MODEL FOR TRUSS SPANS USING GTSTRUDL						
Establish joint coordinates	3	12	40		1	56
Calculate and specify section properties	6	24	80		2	112
Determine point of fixity of four piers in truss spans	8	32	108		2	150
Calculate and specify beam member section properties of all piers	3	12	40		1	56
Determine point of fixity of piers in approach spans	4	16	64		2	86
Determine superstructure stiffness of approach spans	3	12	40		1	56
Determine support type and stiffness at expansion joints between truss and approach spans	1	4	16		1	22
Sub-Total Item 3.	28	112	388	0	10	538

EXHIBIT B
BUDGET TABLE

Engineering Task	Hours					
	Project Manager	Project Engineer	Design Engineer	CADD Tech.	QC Reviewer	TOTAL
TASK 4 EXECUTION AND CALIBRATION OF COMPUTER MODEL						
Calibrate model for LL cases using strain measurements	5	32	64		1	102
Stiffness analysis for DL and Temp. changes for the four support cases	3	16	32		1	52
Stiffness analysis for AASHTO fatigue LL+I in each lane	5	32	64		1	102
Stiffness analysis for five State vehicles in each lane	5	32	64		1	102
Develop a database for automatic processing of FEM output	5	32	64		1	102
Sub-Total Item 4.	23	144	288	0	5	460
TASK 5 MAXIMUM FORCES AND STRENGTH RATINGS OF TRUSS MEMBERS						
Determine max LL+I tension/compression forces for all members	3	16	32		1	52
Determine max tension/compression member forces due to temperature load from database	3	8	16		1	28
Compute tension/compression strengths of all primary/secondary truss members, store in database	4	32	64		2	102
Evaluate effects of secondary bending in truss members at joints	4	32	64		2	102
Strength ratings per AASHTO LRFD load groups from the database	3	20	40		1	64
Sub-Total Item 5.	17	108	216	0	7	348
TASK 6 TABULATION OF TENSION MEMBERS WITH FATIGUE DETAILS AND STRESSES						
Identify and tabulate members in tension under total load (DL+LL+I+T)	3	8	32		1	44
Categorize and tabulate fatigue details per AASHTO for all tension members	3	8	32		1	44
Tabulate nominal LL+I stress range for fatigue details on all tension members	3	8	32		1	44
Adjust stress ranges at fatigue details due to secondary bending, section loss, etc.	3	8	32		1	44
Tabulate max total tensile stress due to DL+LL+I+T for fracture for the four support cases	3	8	32		1	44
Sub-Total Item 6.	15	40	160	0	5	220

EXHIBIT B
BUDGET TABLE

Engineering Task	Hours					
	Project Manager	Project Engineer	Design Engineer	CADD Tech.	QC Reviewer	TOTAL
TASK 7 REMAINING FATIGUE LIVES FOR TENSION TRUSS MEMBERS						
Include fatigue strength curve equations for all tension members in database	3	16	32		1	52
Include effective stress ranges per University of Minnesota measured stress range histograms	3	16	32		1	52
Estimate/extrapolate the effective stress range and the maximum stress range for other tension members from University of Minnesota test data and calibrated model	3	16	32		1	52
Adjust loading stress ranges for local effects	3	16	32		1	52
Selection of eight most critical members in coordination with the State	4	8	8			20
Adjust loading stress ranges for assumed 10% loss on 8 members	3	8	16		1	28
Compute and tabulate remaining fatigue lives for all tension members	3	40	80		1	124
Compute/tabulate remaining fatigue life and probability of fatigue cracking	3	20	40		1	64
Sub-Total Item 7.	25	140	272	0	7	444
TASK 8 IDENTIFICATION OF FRACTURE CRITICAL MEMBERS						
Develop tension/compression failure criteria	5	40	60		1	106
Compute tension/compression failure forces for all primary/secondary truss members/connections	6	40	80		2	128
Remove one tension member in the model and check against failure criteria	3	16	32		1	52
Meet with the State to rech concensus on approach for the remaining evaluation (Hours in Task 13)						
Repeat the process for all tension members in database	10	60	120		2	192
Tabulate all fracture critical members in order of fatigue/fracture failure probability	3	20	40		1	64
Sub-Total Item 8.	27	176	332	0	7	542
TASK 9 REPAIR PLANS FOR EIGHT FRACTURE CRITICAL MEMBERS						
Design and prepair conceptual plans for contingency repair of the eight members	8	66	140	120	4	338
Sub-Total Item 9.	8	66	140	120	4	338

EXHIBIT B
BUDGET TABLE

Engineering Task	Hours					
	Project Manager	Project Engineer	Design Engineer	CADD Tech.	QC Reviewer	TOTAL
TASK 10 CONCEPTS FOR IMPROVING STRUCTURAL REDUNDANCY & MINIMIZING TRUSS TENSILE STRESSES						
Develop concepts for adding structual redundancy and minimizing fatigue stresses	3	20	40		1	64
Meet with the State to reach concensus on concepts to evaluate (Hours in Task 13)						
Evaluate improvement in structural redundancy for up to two concepts	6	40	80		2	128
Evaluate improvement in truss member fatigue stresses for up to two concepts	6	40	80		2	128
Sub-Total Item 10.	15	100	200	0	5	320
TASK 11 CONCEPTUAL PLANS FOR DECK REMOVAL, STRUCTURAL CHANGES AND DECK REPLACEMENT						
Analysis for critical stresses at various stages of deck removal and replacement for applicable	6	48	96		2	152
Study construction methods and use of light weight concrete	3	20	40		1	64
Develop multiple staging and sequencing alternatives for deck removal and replacement in truss spans	3	20	40		1	64
Compare and evaluate alternatives for cost and member stresses to determine best solution	6	32	64		2	104
Prepare conceptual plans for a procedure of deck removal, structural changes and deck replacement	6	20	80	120	2	228
Sub-Total Item 11.	24	140	320	120	8	612
TASK 12 FINAL REPORT AND MEETINGS						
Prepare condensed tables and figures for report	2	20	40	40	2	104
Write and type report	8	120	0	20	8	156
QA/QC review	32	16	0		32	80
Revisions per State comments	4	24	0	16	4	48
Sub-Total Item 12.	46	180	40	76	46	388

EXHIBIT B
BUDGET TABLE

Engineering Task	Hours					
	Project Manager	Project Engineer	Design Engineer	CADD Tech.	QC Reviewer	TOTAL
TASK 13 MEETINGS WITH MN/DOT BRIDGE OFFICE						
Progress meeting approximately 6 months after notice to proceed	8	16				24
Progress meeting approximately 8 months after start of contract	8	16				24
Progress meeting approximately 10 months after start of contract	8	16				24
Progress meeting approximately 12 months after strart of contract	8	16				24
Progress meeting approximately 14 months after start of contract	8	16			16	40
Final meeting approximately 16 months after start of contract	8	16			16	40
Sub-Total Item 13.	48	96	0	0	32	176
TOTAL	306	1398	2624	316	138	4782

EXHIBIT B
BUDGET TABLE

DIRECT LABOR						
SHEET TITLE / TASK	Proj. Mgr.	Proj. Engr.	Des. Engr.	CADD Tech	QA/QC	TOTAL
DIRECT LABOR RATE	$53.04	$41.84	$33.12	$25.88	$72.00	$37.59
HOURS	306	1398	2624	316	138	4782
DIRECT LABOR	$16,230.24	$58,492.32	$86,906.88	$8,178.08	$9,936.00	$179,743.52

DIRECT EXPENSES				
ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
LOCAL MILEAGE	500	Mile	$0.36	$180.00
LONG DISTANCE TRAVEL	9	Man Trips	$1,800.00	$16,200.00
BLACKLINE PRINTS	130	Print	$1.00	$130.00
PHOTOCOPIES	400	Copy	$0.05	$20.00
PHOTOCOPIES - COLOR	200	Copy	$1.50	$300.00
PRINTING				$450.00
PHOTOGRAPHY				$100.00
MISCELLANEOUS (postage, delivery, etc.)				$500.00
MATERIALS/TOOLS FOR DIRECT BEARING/JOINTS MEASUREMENTS				$500.00
LIFT TRUCK RENTAL FOR BEARING INSPECTION/MONITORING (6 DAYS)				$1,800.00
INDEPENDENT REVIEW BY DR. ROBERT DEXTER				$3,000.00
Direct Expenses				$23,180.00

SUMMATION OF COSTS	
Direct Labor	$179,743.52
Overhead Applied To Direct Labor @ 130.26%	$234,133.91
Fixed Fee @ 12%	$49,665.29
Direct Expenses	$23,180.00
Total Contract Amount	$486,722.72

Exhibit C Invoice

To: Consultant Services
Minnesota Department of Transportation
Transportation Building, Mail Stop 680
395 John Ireland Boulevard
St. Paul, Minnesota 55155

Estimated Completion: _______%
(from Column 6 Progress Report)

Period Ending: ________________
Invoice Date: ________________

Copy: Scott Pierson
Project Manager

INVOICE NO._______

Re: Mn/DOT Agreement No.: 85907

Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)

State Project Number: 2783-9340

Trunk Highway: 35W

Contract Expiration Date: January 1, 2006

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Salary Costs: (See Exhibit B for breakdown)	$179,743.52			
2. Overhead Costs: Rate = 130.26% (Direct Salaries * Overhead Rate)	$234,133.91			
3. Fixed Fee (Profit): (Fixed Fee = $ * percent complete)	$ 49,665.29			
4. Other Direct Costs: (Attach support documentation)	$ 23,180.00			
Net Earnings Totals:	$486,722.72			
			Total Amount Due This Invoice:	

For State Use Only

I certify that the above statement is correct and payment has not been received.

Signature: ____________________

Print Name: ____________________

Title: ____________________

Billing Address: URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: (612) 370-0070

Approved for Payment:

____
Contract Administrator Date

Exhibit D
Progress Report Form

To: Scott Pierson
Project Manager

From:_______________

For Invoice no.: ___________________
Contract Expiration Date: January 1, 2006
Type of Work: ___________________

State Project Number: 2783-9340

Billing Period: From _________ to ___________

Project Description: Evaluation of Bridge No. 9340
(I35W over Mississippi River)

Trunk Highway: 35W

Task Description	% of Total Contract	ENGINEERING ESTIMATE				Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	% of Budget Hours Used
		% Work Completed This Period	% Work Completed to Date	Weight % Completed This Period	Weight % Work Completed to Date				
1	2	3	4	5	6	7	8	9	10
Task 1	4.6					222			
Task 2	3.6					174			
Task 3	11.3					538			
Task 4	9.6					460			
Task 5	7.3					348			
Task 6	4.6					220			
Task 7	9.3					444			
Task 8	11.3					542			
Task 9	7.1					338			
Task 10	6.7					320			
Task 11	12.8					612			
Task 12	8.1					388			

Rev 7/03 CSS

Exhibit D
Progress Report Form

Task 13	3.7					176			
TOTALS:	100					4782			

I certify that the above statement is correct:

Contractor's Project Manager Date

Approved and recommended for payment:

State's Project Manager Date

If Budgeted Hours Used for task exceeds 100%, attach explanation.

This payment Progress Report must be submitted, within five working days after receipt, by State Project Manager for payment execution.

Mn/DOT Contract No. 85907

CFMS No. A57100

AMENDMENT NO. 1 TO Mn/DOT CONTRACT NO. 85907

Contract Start Date: **December 23, 2003**

Total Contract Amount:	**$526,279.00**
Original Contract:	**$486,722.72**
Previous Amendment(s) Total:	**$ 0.00**
Current Amendment:	**$ 39,556.28**

State Project (SP): 2783-9340

Trunk Highway (TH): 35W

Project Identification: A bridge study to evaluate the superstructure for Bridge No. 9340; I35W over Mississippi River, in Minneapolis

This amendment is by and between the State of Minnesota, through its Commissioner of Transportation ("State") and URS, Incorporated ("Contractor").

Recitals

1. The State has a contract with the Contractor identified as Mn/DOT Contract Number 85907 ("Original Contract") to provide a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study will allow the State to develop a repair strategy for potential future repairs.
2. The original contract is amended to include traffic data collection services necessary for the structural evaluation of Bridge 9340.
3. Exhibits B-1 and Exhibits C-1 are attached and incorporated into this Contract.
4. The State and the Contractor are willing to amend the Original Contract as stated below.

Contract Amendment

In this Amendment deleted contract terms will be ~~struck-out~~ and the added contract terms will be underlined.

REVISION 1. Article 2. **"Scope of Work"** is amended as follows:
Under **Section 3 "Detailed Project Tasks"** of Exhibit A add the following:

Task 14 – Traffic Data Collection

Determine Average Daily Traffic (ADT) and vehicle classification for northbound and southbound directions on Bridge 9340. The vehicle classification will be broken down to only include the percentage of automobiles and commercial trucks in the traffic stream.

14.1 Data Collection and ADT

Meet with the State personnel to gather existing traffic data from their Automatic Traffic Recorder (ATR) data system detectors. Traffic data assumed to be available and accurate for year 2003.

Determine the ADT for northbound and southbound directions based on compilation and calculation of the various ATR sites in the area.

14.2 Videotape Traffic

Video record the traffic using the State's Closed Circuit Television (CCTV) surveillance camera located on the south side of the bridge. Video recording will take place for 7 continuous days at 24 hours per day.

Provide new digital recorders to be installed on computers provided by the Contractor. At project completion the recorders become property of the State.

14.3 Classification Counts
Observe the videotaped traffic and determine the number of commercial vehicles in the traffic stream using the State's field classification count form.

14.4 Memorandum
Prepare a draft and final memorandum on findings of vehicle classification counts.

14.5 Project Management
Meet with the State's staff to confirm findings. Perform other administrative duties as necessary.

REVISION 2. Article 4 **"Consideration of Payment"** is amended as follows:
4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	~~$179,743.52~~	$195,151.52
2. Overhead:	~~$234,133.91~~	$253,702.07
3. Fixed Fee:	~~$ 49,665.29~~	$ 53,162.91
4. Direct Expenses:	~~$ 23,180.00~~	$ 24,262.50
Total Contract Amount:	~~$486,722.72~~	$526,279.00

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% **and 127.00%** of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B and Exhibit B-1. Any other direct costs not listed in Exhibit B and Exhibit B-1 must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B and Exhibit B-1 for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed ~~$486,722.72~~ **$526,279.00.**

REVISION 3. Article 5 **"Terms of Payment"** is amended as follows:
5.1 The Contractor will use the format set forth in ~~Exhibit C~~ Exhibit C-1 when submitting Invoices.

5.2 The Contractor will submit the monthly progress report set forth in Exhibit D showing the progress of work in work hours according to the tasks listed in Article 2 Scope of Work as amended.

Except as amended herein, the terms and conditions of the Original Contract and all previous amendments remain in full force and effect.

STATE ENCUMBRANCE VERIFICATION

Individual certifies that funds have been encumbered as required by Minn. Stat. §§ 16A.15 and 16C.05.

Signed:

Date: 7-8-2004

CFMS Contract No. A- 57100

CONTRACTOR

The Contractor certifies that the appropriate person(s) have executed the contract on behalf of the Contractor as required by applicable articles, bylaws, resolutions, or ordinances.

By:

Title: V.P.

Date: 7-6-04

By:

Title: V.P.

Date: 7-6-04

STATE AGENCY

ORIGINAL SIGNED BY

By: Marthand Nookala

(with delegated authority)

Division Director

Title:

Date: 7/9/04

COMMISSIONER OF ADMINISTRATION

By:

Date: July 12, 2004

EXHIBIT B-1
BUDGET TABLE

1. Staff Hour Estimate - Additional Tasks

Task	Description	Project Manager	Engineer / Sr. Tech	Technician	Total
14.1	Gather Traffic Data and Determine ADT	4	16		20
14.2	Videotape Traffic		10	20	30
14.3	Classiication Count		30	600	630
14.4	Draft and Final Memo	4	8		12
14.5	Project Mgmt and Meetings	8	4		12
	TOTAL	16	68	620	704

2. Direct Expenses - Additional Tasks

Automobile Mileage ($0.375/mile)	12	trips @	25	miles	$112.50
Postage and Delivery					$20.00
Photocopying and Document Production					$50.00
Digital Data Recorder					$900.00
Subtotal Expenses					$1,082.50

3. Total Costs - Additional Tasks

Employee Classification	Average Hourly Rate	Hours	Amount
Project Manager	$52.00	16	$832.00
Engineer	$32.00	68	$2,176.00
Technician	$20.00	620	$12,400.00
Labor Subtotal		704	$15,408.00
Overhead	127.00%		$19,568.16
Subtotal			$34,976.16
Profit	10%		$3,497.62
Expenses			$1,082.50
Total Amendment 1 Contract Amount			$39,556.28

4. Total Amended Contract Cost

	Original Contract	Amendment No. 1	Revised Amounts
Labor	$179,743.52	$15,408.00	$195,151.52
Overhead	$234,133.91	$19,568.16	$253,702.07
Fixed Fee	$49,665.29	$3,497.62	$53,162.91
Direct Expense	$23,180.00	$1,082.50	$24,262.50
Total Cost	$486,722.72	$39,556.28	$526,279.00

Exhibit C-1 Invoice

To: Consultant Services
Minnesota Department of Transportation
Transportation Building, Mail Stop 680
395 John Ireland Boulevard
St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Period Ending: ____________
Invoice Date: ____________

Copy: Scott Pierson
Project Manager

INVOICE NO.______

Re: Mn/DOT Agreement No.: 85907

Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)

State Project Number: 2783-9340

Trunk Highway: 35W

Contract Expiration Date: January 1, 2006

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Salary Costs: (See Exhibit B for breakdown)	$195,151.52			
2. Overhead Costs: Rate = 130.26% and 127.00% (Direct Salaries * Overhead Rate)	$253,702.07			
3. Fixed Fee (Profit): (Fixed Fee = $ * percent complete)	$ 53,162.91			
4. Other Direct Costs: (Attach support documentation)	$ 24,262.50			
Net Earnings Totals:	$526,279.00			
			Total Amount Due This Invoice:	

For State Use Only

I certify that the above statement is correct and payment has not been received.

Signature: ____________

Print Name: ____________

Title: ____________

Billing Address: URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: (612) 370-0070

Approved for Payment:

____
Contract Administrator Date

AMENDMENT NO. 2 TO Mn/DOT CONTRACT NO. 85907

Contract Start Date: **December 23, 2003**

Total Contract Amount:	**$553,711.75**
Original Contract Amount:	**$486,722.72**
Previous Amendment(s) Total:	**$ 39,556.28**
Current Amendment Amount:	**$ 27,432.75**

State Project Number (SP): 2783-9340 **Trunk Highway Number (TH):** 35W

Project Identification: A bridge study to evaluate the superstructure for Bridge No. 9340; I35W over Mississippi River, in Minneapolis.

This amendment is by and between the State of Minnesota, through its Commissioner of Transportation ("State") URS, Incorporated ("Contractor").

Recitals

1. State has a Contract with Contractor identified as Mn/DOT Contract Number 85907 ("Original Contract") to provide a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study will allow the State to develop a repair strategy for potential future repairs.
2. The original contract is being amended because the unique and complex nature of the work made it very difficult to assess the required effort before the start of the project.
3. Exhibits B-2 and Exhibits C-2 are attached and incorporated into this Contract.
4. State and Contractor are willing to amend the Original Contract as stated below.

Contract Amendment

In this Amendment deleted contract terms will be ~~struck out~~ and the added contract terms will be **bolded** and underlined.

REVISION 1. Article 1 **"Term of Contract"** is amended as follows:

1.1 Effective date: The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.

1.2 Expiration date: ~~January 1, 2006~~ **June 30, 2006**, or until all obligations have been approved, which ever occurs first.

1.3 Survival terms: The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.

1.4 Exhibits: Exhibits A through D are attached and incorporated into this Contract.

REVISION 2. Article 2 Exhibit A **"Scope of Work and Deliverables"** is amended as follows:
Section 3 "Detailed Project Tasks" is amended as follows:

Under **Task 3 – Development of 3-D Finite Element Model for Truss Spans** insert the following:

3.7 Model geometry of the structure with the computer in inches instead of feet and have GTSTRUDL technical service verify the results to trace the cause of the erratic results.

Under **Task 8 – Identification of Fracture Critical Members** insert the following:

8.7 Investigate the cause of the out of plane bending due to the stringer bearings not being symmetrical as constructed at the deck expansion joints.

Under **Task 12 – Final Report of Findings** insert the following:

12.6 Summarize the additional analysis results and tabulate them into the final report.

REVISION 3. Article 4 **"Consideration of Payment"** is amended as follows:

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	~~$179,743.52~~	~~$195,151.52~~	**$206,258.66**
2. Overhead:	~~$234,133.91~~	~~$253,702.07~~	**$267,533.79**
3. Fixed Fee:	~~$ 49,665.29~~	~~$ 53,162.91~~	**$ 55,656.80**
4. Direct Expenses:	~~$ 23,180.00~~	~~$ 24,262.50~~	**$ 24,262.50**
Total Contract Amount:	~~$486,722.72~~	~~$526,279.00~~	**$553,711.75**

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% and 127.00% **and 124.53%** of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B and Exhibit B-1 **and Exhibit B-2.** Any other direct costs not listed in Exhibit B and Exhibit B-1 **and Exhibit B-2** must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B and Exhibit B-1 **and Exhibit B-2** for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed ~~$486,722.72~~ ~~$526,279.00~~ **$553,711.75.**

REVISION 4. Article 5 **"Terms of Payment"** is amended as follows:

5.1 The Contractor will use the format set forth in ~~Exhibit C~~ ~~Exhibit C-1~~ **Exhibit C-2** when submitting Invoices.

5.2 The Contractor will submit the monthly progress report set forth in Exhibit D showing the progress of work in work hours according to the tasks listed in Article 2 Scope of Work as amended.

Except as amended herein, the terms and conditions of the Original Contract and all previous Amendments remain in full force and effect.

STATE ENCUMBRANCE VERIFICATION

Individual certifies that funds have been encumbered as required by Minn. Stat. §§ 16A.15 and 16C.05.

Signed:

Date: 11-2-2005

CFMS Contract No. A- 57100

CONTRACTOR

Contractor certifies that the appropriate person(s) have executed the Contract on behalf of Contractor as required by applicable articles, bylaws, resolutions or ordinances.

By: Donald J.

Title: V.P.

Date: 10-28-05

By:

Title: V.P.

Date: 10-28-05

STATE AGENCY

ORIGINAL SIGNED BY

By: Richard A. Stehr

(with delegated authority)

Division Director

Title:

Date: 11-2-05

COMMISSIONER OF ADMINISTRATION

By:

Date: Nov 4, 2005

EXHIBIT B-2
BUDGET TABLE

Direct Labor - Amendment No. 2

Description	Project Manager	Project Engineer	Design Engineer	Total
Computer Modeling	8	20	90	118
Redundancy Analysis	8	20	80	108
Final Report Preparation	8	20	40	68
TOTAL	24	60	210	294

Total Costs - Amendment No. 2

Employee Classification	Rate	Hours	Amount
Project Manager	$55.16	24	$1,323.84
Project Engineer	$45.00	60	$2,700.00
Design Engineer	$33.73	210	$7,083.30
Labor Subtotal		294	$11,107.14
Overhead	124.53%		$13,831.72
Subtotal			$24,938.86
Profit	10%		$2,493.89
Direct Expenses			$0.00
Total Amendment 2 Contract Amount			$27,432.75

Total Amended Contract Cost

	Original Contract	Amendment No. 1	Amendment No. 2	Revised Amounts
Labor	$179,743.52	$15,408.00	$11,107.14	$206,258.66
Overhead	$234,133.91	$19,568.16	$13,831.72	$267,533.79
Fixed Fee	$49,665.29	$3,497.62	$2,493.89	$55,656.80
Direct Expense	$23,180.00	$1,082.50	$0.00	$24,262.50
Total Cost	$486,722.72	$39,556.28	$27,432.75	$553,711.75

Exhibit C-2 Invoice

INVOICE NO.______

To: Consultant Services
Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard, St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Period Ending: ____________
Invoice Date: ____________

Copy: Scott Pierson, Project Manager
Minnesota Department of Transportation
Bridge Office, Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Re: Mn/DOT Contract No. 85907
Contract Expiration Date: ~~January 1, 2006~~ June 30, 2006
Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)
SP Number: 2783-9340 TH Number: 35W

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Salary Costs: (See Exhibit B-2 for Breakdown)	$206,258.66			
2. Overhead Costs: Rate =130.26% and 127.00% and 124.53%. (Salary*Overhead Rate)	$267,533.79			
3. Fixed Fee (Profit): Rate = 12.00% , 10.00% and 10.00%. (Fixed Fee = $ * Percent Complete)	$ 55,656.80			
4. Direct Expense Costs: (Attach Supporting Documentation)	$ 24,262.50			
Net Earnings Totals:	$553,711.75			
Total Amount Due This Invoice:				

Activity Code	Total Billing to Date	Amount Previously Billed	Billed This Invoice
NA			
NA			
NA			
*Total**			

*Must Match Net Earnings Total Above

I certify that the above statement is correct and payment has not been received.

Signature: ____________________

Print Name: ____________________

Title: ____________________

Billing Address: URS, Inc.
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: (612) 370-0070

Approved for Payment: ____________________

Date: ____________________

For Consultant Services Use Only

AMENDMENT NO. 3 TO Mn/DOT CONTRACT NO. 85907

Contract Start Date: **December 23, 2003**

Total Contract Amount:	**$574,362.99**
Original Contract Amount:	**$486,722.72**
Previous Amendment(s) Total:	**$ 66,989.03**
Current Amendment Amount:	**$ 20,651.24**

State Project Number (SP) : 2783-9340 **Trunk Highway Number (TH):** 35W

Project Identification: A bridge study to evaluate the superstructure for Bridge No. 9340; I35W over Mississippi River, in Minneapolis.

This amendment is by and between the State of Minnesota, through its Commissioner of Transportation ("State") URS, Incorporated ("Contractor").

Recitals

1. State has a Contract with Contractor identified as Mn/DOT Contract Number 85907 ("Original Contract") to provide a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study will allow the State to develop a repair strategy for potential future repairs.

2. The original contract is being amended because the unique and complex nature of the work made it very difficult to assess the required effort before the start of the project. This amendment is for extra work and time that are necessary to complete the project.

3. Exhibits B-3 through C-3 are attached and incorporated into this Contract.

4. State and Contractor are willing to amend the Original Contract as stated below.

Contract Amendment

In this Amendment deleted contract terms will be ~~struck-out~~ and the added contract terms will be **bolded** and underlined.

REVISION 1. Article 1 **"Term of Contract"** is amended as follows:

1.1 Effective date: The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.
1.2 Expiration date: ~~January 1, 2006~~ ~~June 30, 2006~~ September 30, 2006, or until all obligations have been approved, which ever occurs first.
1.3 Survival terms: The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.
1.4 Exhibits: Exhibits A through D are attached and incorporated into this Contract.

REVISION 2. Article 2 Exhibit A **"Scope of Work and Deliverables"** is amended as follows:
Section 3 "Detailed Project Tasks" is amended as follows:

Under **Task 8 – Identification of Fracture Critical Members** insert the following:

8.8 **Incorporate the unexpected, preexisting overstress in the redundancy analysis and evaluate the structural consequences after the removal of the critical truss members under investigation.**

8.9 **Design retrofits of the eight critical members separately for each half of the bridge for different loads**

8.10 **Incorporate the results from Tasks 8.8 and 8.9 in the final report.**

REVISION 3. Article 2 **"Scope of Work"** is amended as follows:

2.1 The services to be provided for under this Contract by the Contractor are:
The project goal is to identify structural members of the truss-arch spans that are most susceptible to cracking, identify the most critical members, and evaluate how the bridge will perform if any one of those critical members were removed. The project will evaluate how dead and live loads are redistributed in the bridge when failure occurs in the critical members and if/how adjacent members will fail when the loads are redistributed. The project will identify repairs to critical members and identify a preferred deck replacement staging in the truss-arch spans. The analysis will concentrate on the truss-arch portion of the bridge.

See Exhibit A for additional information.

2.2 Deliverables are defined as the work product created or supplied by the Contractor pursuant to the terms of this Contract. The brief summary of the deliverables of this Contract are as follows:

Items	Date Due
Progress report one • Five hard copies, 8 ½" x 11" bond	**July 1, 2004**
Progress report two • Five hard copies, 8 ½" x 11" bond	**September 1, 2004**
Progress report three • Five hard copies, 8 ½" x 11" bond	**November 1, 2004**
Progress report four • Five hard copies, 8 ½" x 11" bond	**January 1, 2005**
Preliminary report and conceptual plans • Five hard copies draft preliminary report on 8 ½" x 11" bond • Five hard copies draft conceptual plans on 11" x 17" bond • One electronic file each draft preliminary report in Microsoft Word, and draft preliminary report of conceptual plans in Microstation.	**March 1, 2005**
Draft final report and draft final conceptual plans • Five hard copies draft final report on 8 ½" x 11" bond • Five hard copies draft final report of conceptual plans on 11" x 17" bond • One electronic file each draft final report in Microsoft Word, and draft final conceptual plans in Microstation.	**May 1, 2005**
Final report • Five certified hard copies final report on 8 ½" x 11" bond • Five certified hard copies final report of conceptual plans	**~~May 17, 2005~~ June 30, 2006**

on 11" x 17" bond

- One electronic file each final report in Microsoft Word, and final conceptual plans in Microstation.

See Exhibit A for the details on the deliverables to be provided by the Contractor.

The State's Project Manager has the authority to update and adjust all project schedules when necessary at progress meetings within the terms of the Contract.

REVISION 4. Article 4 **"Consideration of Payment"** is amended as follows:

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	~~$179,743.52~~	~~$195,151.52~~	~~$206,258.66~~	$214,620.06
2. Overhead:	~~$234,133.91~~	~~$253,702.07~~	~~$267,533.79~~	$277,946.24
3. Fixed Fee:	~~$ 49,665.29~~	~~$ 53,162.91~~	~~$ 55,656.80~~	$ 57,534.19
4. Direct Expenses:	~~$ 23,180.00~~	~~$ 24,262.50~~	~~$ 24,262.50~~	$ 24,262.50
Total Contract Amount:	~~$486,722.72~~	~~$526,279.00~~	~~$553,711.75~~	$574,362.99

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% and 127.00% and 124.53% of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B and Exhibit B-1 and Exhibit B-2 **and Exhibit B-3.** Any other direct costs not listed in Exhibit B and Exhibit B-1 and Exhibit B-2 **and Exhibit B-3** must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B and Exhibit B-1 and Exhibit B-2 **and Exhibit B-3** for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed ~~$486,722.72~~ ~~$526,279.00~~ ~~$553,711.75~~ $574,362.99.

REVISION 5. Article 5 **"Terms of Payment"** is amended as follows:

5.1 The Contractor will use the format set forth in ~~Exhibit C~~ ~~Exhibit C-1~~ ~~Exhibit C-2~~ **Exhibit C-3** when submitting Invoices.

5.2 The Contractor will submit the monthly progress report set forth in Exhibit D showing the progress of work in work hours according to the tasks listed in Article 2 Scope of Work as amended.

The terms of the Original Contract and all previous Amendments are expressly reaffirmed and remain in full force and effect. The Original Contract and all previous Amendments are incorporated into this Contract by reference. Except as amended herein, the terms and conditions of the Original Contract and all previous Amendments remain in full force and effect.

THE BALANCE OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

STATE ENCUMBRANCE VERIFICATION
Individual certifies that funds have been encumbered as required by Minn. Stat.§§ 16A.15 and 16C.05.

Signed:

Date: 4-12 2006

CFMS Contract No. A- 57100

CONTRACTOR
Contractor certifies that the appropriate person(s) have executed the Contract on behalf of Contractor as required by applicable articles, bylaws, resolutions or ordinances.

By: Donald J. Flemming

Title: V.P.

Date: 4-7-06

By:

Title: V.P.

Date: 4-7-06

STATE AGENCY

By: ORIGINAL SIGNED B,
(with delegated authority) Richard A. Stehr

Title: Division Director

Date: 4/12/06

COMMISSIONER OF ADMINISTRATION

By: Joanne Wagner

Date: 4/13/06

Exhibit B-3
Budget Table

Direct Labor - Amendment 3

Description	Project Manager	Project Engineer	Design Engineer	Total
Redundancy Analysis	4	15	40	59
Retrofit Desgn	8	10	35	53
Final Report Preparation	8	40	45	93
TOTAL	20	65	120	205

Total Costs - Amendment 3

Employee Classification	Rate	Hours	Amount
Project Manager	$56.44	20	$1,128.80
Project Engineer	$49.00	65	$3,185.00
Design Engineer	$33.73	120	$4,047.60
Labor Subtotal		205	$8,361.40
Overhead	124.53%		$10,412.45
Subtotal			$18,773.85
Fixed Fee	10%		$1,877.39
Direct Expenses			$0.00
Total Amendment 3 Amount			$20,651.24

Total Amended Contract Cost

	Original Contract	Amendment No. 1	Amendment No. 2	Amendment No. 3	Revised Amounts
Labor	$179,743.52	$15,408.00	$11,107.14	$8,361.40	$214,620.06
Overhead	$234,133.91	$19,568.16	$13,831.72	$10,412.45	$277,946.24
Fixed Fee	$49,665.29	$3,497.62	$2,493.89	$1,877.39	$57,534.19
Direct Expense	$23,180.00	$1,082.50	$0.00	$0.00	$24,262.50
Total Cost	$486,722.72	$39,556.28	$27,432.75	$20,651.24	$574,362.99

Mn/DOT Contract No. 85907

Exhibit C-3
Invoice

INVOICE NO.______

To: Consultant Services
Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard, St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Period Ending: ______________
Invoice Date: ______________

Copy: Scott Pierson, Project Manager
Minnesota Department of Transportation
Bridge Office, Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Re: Mn/DOT Contract No. 85907
Contract Expiration Date: ~~January 1, 2006~~ ~~June 30, 2006~~ September 30, 2006
Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)
SP Number: 2783-9340 TH Number: 35W

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Salary Costs: (See Exhibit B-2 for Breakdown)	$214,620.06			
2. Overhead Costs: Rate =130.26% and 127.00% and 124.53% (Salary*Overhead Rate)	$277,946.24			
3. Fixed Fee (Profit): Rate = 12.00%, 10.00% and 10.00%, (Fixed Fee = $ * Percent Complete)	$ 57,534.19			
4. Direct Expense Costs: (Attach Supporting Documentation)	$ 24,262.50			
Net Earnings Totals:	$574,362.99			
			Total Amount Due This Invoice:	

Activity Code	Total Billing to Date	Amount Previously Billed	Billed This Invoice
NA			
NA			
NA			
Total*			

*Must Match Net Earnings Total Above

I certify that the above statement is correct and payment has not been received.

Signature: ____________________

Print Name: ____________________

Title: ____________________

For Consultant Services Use Only

Billing Address: **URS, Inc.**
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: **(612) 370-0070**

Approved for Payment: ________________

Date: ____________________

Minnesota Department of Transportation

Office of Bridges & Structures
MS 610, 3485 Hadley Ave. No.
Oakdale, MN 55128

October 11, 2006 DRAFT

Donald J. Flemming
Project Manager
URS, Inc.
700 Third Street South
Minneapolis, MN 55415

In reference to: Mn/DOT Contract No.85907 – Amendment 4
State Project Number 2783-9340
Evaluation of Bridge Number 9340

Dear Mr. Flemming:

Enclosed is your executed copy of the above referenced Amendment 4. This Amendment is for the continuation and completion of the structural evaluation of Bridge No. 9340.

This is your authorization to proceed. Please coordinate this project with Scott Pierson, Project Manager at (651) 747-2192.

Please send to me a signed copy of any sub-consultant contracts for this project.

If you have any questions regarding this contract, please contact me.

Sincerely,

Victor E. Crabbe

Victor E. Crabbe
Contract Administrator
Phone: (651) 747-2113
Fax: (651) 747-2108
Email: victor.crabbe@dot.state.mn.us

enclosure

cc: file
Scott Pierson
Project Accounting (2 copies)

3180711661

Mn/DOT Contract No. 85907
CFMS Contract No. A57100

AMENDMENT NO. 4 TO Mn/DOT CONTRACT NO. 85907

Contract Start Date: **December 23, 2003**

Total Contract Amount:	$614,277.75
Original Contract Amount:	$486,722.72
Previous Amendment(s) Total:	$ 87,640.27
Current Amendment Amount:	$ 39,914.76

State Project Number (SP): : 2783-9340 **Trunk Highway Number (TH) : 35W**

Project Identification: A bridge study to evaluate the superstructure for Bridge No. 9340; I35W over Mississippi River, in Minneapolis.

This Amendment is by and between the State of Minnesota, through its Commissioner of Transportation ("State") and URS Corporation ("Contractor").

Recitals

1. State has a Contract with Contractor identified as Mn/DOT Contract Number 85907 ("Original Contract") to provide a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study will allow the State to develop a repair strategy for potential future repairs.

2. The original contract is being amended because the unique and complex nature of the work made it very difficult to assess the required effort before the start of the project. During review of the 95% of the Contractor's submittal, the State added four additional tasks and requested the Contractor to incorporate the results in of the additional tasks in the final report. This amendment is for extra work and time that are necessary to complete the project.

3. Exhibits B-4 through C-4 are attached and incorporated into this Contract.

4. State and Contractor are willing to amend the Original Contract as stated below.

Contract Amendment

In this Amendment deleted contract terms will be ~~struck-out~~ and the added contract terms will be **bolded** and <u>underlined</u>.

REVISION 1. Article 1 **"Term of Contract"** is amended as follows:

1.1	Effective date:	The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.
1.2	Expiration date:	~~September 30, 2006~~, **<u>March 30, 2007</u>**, or until all obligations have been approved, which ever occurs first.
1.3	Survival terms:	The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.
1.4	Exhibits:	Exhibits A through D are attached and incorporated into this Contract.

REVISION 2. Article 2 Exhibit A **"Scope of Work and Deliverables"** is amended as follows:
Section 3 "Detailed Project Tasks" is amended as follows:

Under **Task 8 – Identification of Fracture Critical Members** insert the following:

8.11 **Search for steel toughness for the time period of the original construction of Bridge 9340 and advise on a typical range of Charpy V-Notch toughness values for the steel used in the bridge for use as Guidelines for Inspection Cycles.**

8.12 **Investigate to compare various rating methods: Allowable Stress Design (ASD), Load Factor Design (LFD), Load and Resistance Factor Design (LRFD) and Load Resistance Factor Rating (LRFR) as well as different rating levels for overweight trucks for the bridge. Use the LRFR rating criteria to review the most critical bridge members from a force interaction perspective.**

8.13 **Develop a prioritized list of critical members for determining the inspection cycles of truss chords requiring a close-up inspection with the hatch cover plates removed.**

8.14 **Summarize and tabulate the results from Tasks 8.12 and 8.13, and incorporate the results from Tasks 8.11 through 8.13 in the final report.**

REVISION 3. Article 2 **"Scope of Work"** is amended as follows:

2.1 The services to be provided for under this Contract by the Contractor are:
The project goal is to identify structural members of the truss-arch spans that are most susceptible to cracking, identify the most critical members, and evaluate how the bridge will perform if any one of those critical members were removed. The project will evaluate how dead and live loads are redistributed in the bridge when failure occurs in the critical members and if/how adjacent members will fail when the loads are redistributed. The project will identify repairs to critical members and identify a preferred deck replacement staging in the truss-arch spans. The analysis will concentrate on the truss-arch portion of the bridge.

See Exhibit A for additional information.

2.2 Deliverables are defined as the work product created or supplied by the Contractor pursuant to the terms of this Contract. The brief summary of the deliverables of this Contract are as follows:

Items	**Date Due**
Progress report one • Five hard copies, 8 ½" x 11" bond	**July 1, 2004**
Progress report two • Five hard copies, 8 ½" x 11" bond	**September 1, 2004**
Progress report three • Five hard copies, 8 ½" x 11" bond	**November 1, 2004**
Progress report four • Five hard copies, 8 ½" x 11" bond	**January 1, 2005**
Preliminary report and conceptual plans • Five hard copies draft preliminary report on 8 ½" x 11" bond • Five hard copies draft conceptual plans on 11" x 17" bond • One electronic file each draft preliminary report in Microsoft Word, and draft preliminary report of conceptual plans in Microstation.	**March 1, 2005**
Draft final report and draft final conceptual plans	**May 1, 2005**

- Five hard copies draft final report on 8 ½" x 11" bond
- Five hard copies draft final report of conceptual plans on 11" x 17" bond
- One electronic file each draft final report in Microsoft Word, and draft final conceptual plans in Microstation.

Final report ~~June 30, 2006~~ **December 28, 2007**

- Five certified hard copies final report on 8 ½" x 11" bond
- Five certified hard copies final report of conceptual plans on 11" x 17" bond
- One electronic file each final report in Microsoft Word, and final conceptual plans in Microstation.

See Exhibit A for the details on the deliverables to be provided by the Contractor.

The State's Project Manager has the authority to update and adjust all project schedules when necessary at progress meetings within the terms of the Contract.

REVISION 4. Article 4 **"Consideration of Payment"** is amended as follows:

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	~~$214,620.06~~	**$229,290.38**
2. Overhead:	~~$277,946.24~~	**$296,146.24**
3. Fixed Fee:	~~$ 57,534.19~~	**$ 61,478.63**
4. Direct Expenses:	~~$ 24,262.50~~	**$ 27,362.50**
Total Contract Amount:	~~$574,362.99~~	**$614,277.75**

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% and 127.00% and 124.53% **and 124.06%** of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 **and Exhibit B-4** Any other direct costs not listed in Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 **and Exhibit B-4** must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 **and Exhibit B-4** for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed ~~$574,362.99~~ **$614,277.75**.

The terms of the Original Contract and all previous Amendments are expressly reaffirmed and remain in full force and effect. The Original Contract and all previous Amendments are incorporated into this Contract by reference. Except as amended herein, the terms and conditions of the Original Contract and all previous Amendments remain in full force and effect.

THE BALANCE OF THIS PAGE HAS BEEN INTENSIONALLY LEFT BLANK.

STATE ENCUMBRANCE VERIFICATION

Individual certifies that funds have been encumbered as required by Minnesota Statutes §16A.15 and §16C.05.

Signed:

Date: 10-5-2006

CFMS Contract No. A- 57100

DEPARTMENT OF TRANSPORTATION

By: ORIGINAL SIGNED BY
(with delegated authority) Richard A. Stehr

Title: Division Director

Date: 10/6/06

CONTRACTOR

Contractor certifies that the appropriate person(s) have executed the Amendment on behalf of Contractor as required by applicable articles, bylaws or resolutions.

By:

Title: V.P.

Date: 10/4/06

By:

Title: V.P.

Date: 10.4.2006

COMMISSIONER OF ADMINISTRATION

By: Joanne Wagner

Date: 10/9/06

Exhibit B-4
Budget Table

Direct Labor - Amendment 4

Description	Project Manager	Project Engineer	Design Engineer	Total
1. Guidelines for Inspection Cycles	4	40	16	**60**
2. Load Ratings Under Combined Load Effects	8	40	64	**112**
3. Prioritized Lost of Critical Members for Close-up Inspection	4	8	16	**28**
4. Completion of Final Report	32	48	56	**136**
Total Labor Hours	**48**	**136**	**152**	**336**

Direct Expenses - Amendment 4

	COST
Local Mileage	$100.00
Printing	$3,000.00
Total Direct Expenses Amount	$3,100.00

Total Costs - Amendment 4

Employee Classification	Rate	Hours	Amount
Project Manager	$56.44	48	$2,709.12
Project Engineer	$49.00	136	$6,664.00
Design Engineer	$34.85	152	$5,297.20
Labor Subtotal		336	$14,670.32
Overhead	124.06%		$18,200.00
Subtotal			$32,870.32
Fixed Fee	12.00%		$3,944.44
Direct Expenses			$3,100.00
Total Amendment 4 Amount			**$39,914.76**

Total Amended Contract Cost

	Original Contract	Amendment No. 1	Amendment No. 2	Amendment No. 3	Amendment No. 4	Revised Amounts
Labor	$179,743.52	$15,408.00	$11,107.14	$8,361.40	$14,670.32	$229,290.38
Overhead	$234,133.91	$19,568.16	$13,831.72	$10,412.45	$18,200.00	$296,146.24
Fixed Fee	$49,665.29	$3,497.62	$2,493.89	$1,877.39	$3,944.44	$61,478.63
Direct Expense	$23,180.00	$1,082.50	$0.00	$0.00	$3,100.00	$27,362.50
Total Cost	$486,722.72	$39,556.28	$27,432.75	$20,651.24	$39,914.76	$614,277.75

Exhibit C-4
Invoice

INVOICE NO.______

To: Consultant Services Section
Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard, St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Period Ending: ____________
Invoice Date: ____________

Copy: Scott Pierson, Project Manager
Minnesota Department of Transportation
Bridge Office, Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Re: Mn/DOT Contract No. 85907
Contract Expiration Date: ~~September 30, 2006~~ **March 30, 2007**
Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)
SP Number: 2783-9340 TH Number: 35W

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Labor Costs: (See Exhibit B-4 for Breakdown)	**$229,290.38**			
2. Overhead Costs: Rate = 130.26%, 127.00%, 124.53% and 124.06% (Salary*Overhead Rate)	**$296,146.24**			
3. Fixed Fee (Profit) Costs: Rate = 12.00%, 10.00%, 10.00% and 10.00%. (Fixed Fee = $ * Percent Complete)	**$61,478.63**			
4. Direct Expense Costs: (Attach Supporting Documentation)	**$ 27,362.50**			
Net Earnings Totals:	**$614,277.75**			
			Total Amount Due This Invoice:	

Activity Code	Total Billing to Date	Amount Previously Billed	Billed This Invoice
NA			
NA			
NA			
Total*			

*Must Match Net Earnings Totals Above

For Consultant Services Use Only

I certify that the above statement is correct and payment has not been received.

Signature: ________________

Print Name: ________________

Title: ________________

Billing Address: **URS, Inc.**
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: **(612) 370-0070**

Approved for Payment: ________________

Date: ____________

ESTIMATE OF EXTRA FUNDING FOR COMPLETING FINAL REPORT - BR. 9340

TASKS BEYOND ORIGINAL SCOPE FOR WORK COMPLETION

1. Guidelines for Inspection Cycles - (estimate of steel toughness, crack growth time from an initial flaw to visible, and critical crack size for brittle fracture, etc.)
2. Load Ratings under Combined Load Effects (a comparison of various methods: ASD, LFD, LRFD and LRFR; as well as different rating levels for overweight trucks)
3. Prioritized List of Critical Members for Close-up Inspection (for determining the inspection cycles of truss chords requiring removal of the hatch cover plates)
4. Completion of Final Report (incorporating all comments on draft report and making necessary updates from new tasks above)

ESTIMATED EXTRA DIRECT LABOR

SHEET TITLE / TASK	Proj. Mgr.	Proj. Engr.	Des. Engr.	CAAD Tech	QA/QC	TOTAL
DIRECT LABOR RATE	$56.44	$49.00	$34.85			$43.66
1. GUIDELINES FOR INSPECTION CYCLES	4	40	16			
2. LOAD RATINGS UNDER COMBINED LOAD EFFECTS	8	40	64			
3. PRIORITIZED LIST OF CRITICAL MEMBERS FOR CLOSE-UP INSPECTION	4	8	16			
4. COMPLETION OF FINAL REPORT	32	48	56			
TOTAL HOURS	48	136	152	0	0	336
DIRECT LABOR	$2,709	$6,664	$5,297	$0	$0	$14,670

ESTIMATED DIRECT EXPENSES

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
LOCAL MILEAGE				$100
LONG DISTANCE TRAVEL				
BLACKLINE PRINTS				
PHOTOCOPIES				
PHOTOCOPIES - COLOR				
PRINTING				$3,000
PHOTOGRAPHY				
MISCELLANEOUS (postage, delivery, etc.)				
MATERIALS/TOOLS FOR DIRECT BEARING/JOINTS MEASUREMENTS				
LIFT TRUCK RENTAL FOR BEARING INSPECTION/MONITORING (6 DAYS)				
INDEPENDENT REVIEW BY DR. ROBERT DEXTER				
Direct Expenses				$3,100

SUMMATION OF EXTRA COSTS

Direct Labor	$14,670
Overhead Applied To Direct Labor @ 124.53%	$18,269
Fixed Fee @ 12%	$3,953
Direct Expenses	$3,100
Total Contract Amount	**$39,992**

URS

TRANSMITTAL

Thresher Square
700 Third Street South
Minneapolis, MN 55415
Phone: (612) 370-0700
Fax: (612) 370-1378

DATE: March 26, 2007

TO: Victor E. Crabbe, Contract Administrator
Minnesota Department of Transportation - Bridge Office
3485 Hadley Avenue North
Oakdale, MN 55128-3307

FROM: Don Flemming, PE

SUBJECT: Mn/DOT Contract No. 85907; Amendment No. 5

ITEM(S):	ITEM DESCRIPTION:
5 each;	Contracts Executed by URS

PURPOSE:

☐ as you requested
☐ for your information
☐ for your approval
☐ reply to sender
☐ review and return
☐ return for corrections
☐ approved as submitted
☐ approved as noted
☒ other (see remarks)

REMARKS:

Please do not hesitate to contact me at 612-373-6320 with any questions.

Sent via 3 Hour Courier

Copy to: File No.

Minnesota Department of Transportation

Office of Bridges & Structures
MS 610, 3485 Hadley Ave. No.
Oakdale, MN 55128

Date: April 9, 2007

Donald J. Flemming
URS, Inc.
700 Third Street South
Minneapolis, MN 55415

In reference to: **Mn/DOT Contract No.** 85907; **Amendment No.** 5
SP Number: 2783-9340; **TH Number:** 35W

Dear Mr. Flemming:

Enclosed is your executed copy of the above referenced Amendment. This Amendment is to assist Mn/DOT as it conducts an in-depth fracture critical inspection of the superstructure welds for Bridge 9340.

April 5, 2007 is your authorization to proceed. Please coordinate this project with Scott Pierson, Mn/DOT's Project Manager, at (651) 747-2192.

If you have any questions regarding this Amendment, please contact me.

Sincerely,

Victor E. Crabbe
Contract Administrator

Cc:
File
Scott Pierson, Mail Stop 610
Project Accounting, Mail Stop 215 (2 Copies)

Mn/DOT Contract No. 85907
CFMS Contract No. A57100

AMENDMENT NO. 5 TO Mn/DOT CONTRACT NO. 85907

Contract Start Date: **December 23, 2003**

Total Contract Amount:	$ 635,840.69
Original Contract Amount:	$ 486,722.72
Previous Amendment(s) Total:	$ 127,555.03
Current Amendment Amount:	$ 21,562.94

State Project Number (SP): 2783-9340 **Trunk Highway Number (TH):** 35W

Project Identification: A bridge study to evaluate the superstructure for Bridge No. 9340; I35W over Mississippi River, in Minneapolis.

This Amendment is by and between the State of Minnesota, through its Commissioner of Transportation ("State") and URS Corporation ("Contractor").

Recitals

1. State has a Contract with Contractor identified as Mn/DOT Contract Number 85907 ("Original Contract") to provide a comprehensive study to evaluate the truss-arch superstructure for Bridge 9340. This bridge is a major I35W structure that spans the Mississippi River in Minneapolis. In the past various structural components of the truss-arch have exhibited cracking that required repairs. Results of this study indicate that it is critical for the State to have bridge repair plans prepared for construction letting in the spring of 2007.
2. The original contract is being amended because the State is in need of Contractor assistance in the inspection of superstructure steel welds for Bridge 9340.
3. Exhibits B-5 through C-5 are attached and incorporated into this Contract.
4. State and Contractor are willing to amend the Original Contract as stated below.

Contract Amendment

In this Amendment deleted contract terms will be ~~struck out~~ and the added contract terms will be **bolded** and underlined.

REVISION 1. Article 1 **"Term of Contract"** is amended as follows:

1.1 Effective date: The date that all required signatures are obtained by the State, pursuant to Minnesota Statutes Section 16C.05, subdivision 2.

1.2 Expiration date: ~~March 30, 2007~~ **March 30, 2008,** or until all obligations have been approved, which ever occurs first.

1.3 Survival terms: The following clauses survive the expiration or termination of this contract: 11. Governing Law, Jurisdiction, and Venue; 22. Audits and Inspections; 23. Government Data Practices and Intellectual Property; 24. Liability; 29. Publicity and Endorsement; and 36. Data Disclosure.

1.4 Exhibits: Exhibits A through D are attached and incorporated into this Contract.

REVISION 2. Exhibit A **"Scope of Work and Deliverables"** is amended as follows:

Under Section 3 "Detailed Project Tasks" insert the following:

Task 15 – Bridge Inspection

Contractor will assist Mn/DOT as it conducts an in-depth fracture critical inspection of the superstructure welds for Bridge 9340:

- **Inspections will be performed by Mn/DOT personnel. They will begin in the spring of 2007. The south truss span will be the first unit inspected. An inspection progress meeting will be scheduled by Mn/DOT's inspection staff at approximately the mid point of south truss span inspections.**
- **Contractor will be on-site a minimum of two days prior to the progress meeting to observe inspection procedures and the progress of inspections, and to review all inspection reports completed to date.**
- **Contractor will attend and participate in the progress meeting. Items of discussion will include the overall status of inspections to date, the inspection/testing procedures being utilized, and any questions or concerns of the inspection personnel.**

REVISION 3. *Article 4 "**Consideration of Payment**" is amended as follows:*

4.1 The Contractor will be paid on a Cost Plus Fixed Fee (profit) basis as follows:

1. Labor:	~~$229,290.38~~	**$226,370.70**
2. Overhead:	~~$296,146.24~~	**$304,680.15**
3. Fixed Fee:	~~$ 61,478.63~~	**$ 63,352.34**
4. Direct Expenses:	~~$ 27,362.50~~	**$ 31,437.50**
Total Contract Amount:	~~$614,277.75~~	**$635,840.69**

The Contractor will be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Minnesota Department of Transportation Travel Regulations". The Contractor will not be reimbursed for travel and subsistence expenses incurred outside the State of Minnesota unless it has received prior written approval from the State for such out of state travel. The State of Minnesota will be considered the home base for determining whether travel is "out of state".

4.2 The overhead rate of 130.26% and 127.00% and 124.53% and 124.06% and **120.53%** of direct Salary Costs will be used on a provisional basis determined by the State's Audit Section.

4.3 Allowable direct costs include project specific costs listed in Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 and Exhibit B-4 **and Exhibit B-5** Any other direct costs not listed in Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 and Exhibit B-4 **and Exhibit B-5** must be approved, in writing, by the State's Authorized Agent prior to incurring costs.

4.4 See Exhibit B and Exhibit B-1 and Exhibit B-2 and Exhibit B-3 and Exhibit B-4 **and Exhibit B-5** for Budget Details on the Contractor and its subcontractor(s).

4.5 The State's total obligation for all compensation and reimbursements to the Contractor will not exceed ~~$614,277.75~~ **$635,840.69**.

The terms of the Original Contract and all previous Amendments are expressly reaffirmed and remain in full force and effect. The Original Contract and all previous Amendments are incorporated into this Contract by reference. Except as amended herein, the terms and conditions of the Original Contract and all previous Amendments remain in full force and effect.

THE BALANCE OF THIS PAGE HAS BEEN INTENSIONALLY LEFT BLANK.

STATE ENCUMBRANCE VERIFICATION
Individual certifies that funds have been encumbered as required by Minnesota Statutes §16A.15 and §16C.05.

Signed:
Date: 4.3.2007
CFMS Contract No. A- 57100

CONTRACTOR
Contractor certifies that the appropriate person(s) have executed the Amendment on behalf of Contractor as required by applicable articles, bylaws or resolutions.

By:
Title: V.P.
Date: 3/22/07

By:
Title: V.P.
Date: 3/26/2007

DEPARTMENT OF TRANSPORTATION

By: ORIGINAL SIGNED BY
Richard Arnebeck
Division Director
(with delegated authority)
Title:
Date: 4/4/07

COMMISSIONER OF ADMINISTRATION

By: Joanne Wagner
Date: 4/5/07

Exhibit B-5

Budget Table

DIRECT LABOR FOR BRIDGE INSPECTION ASSISTANCE - Amendment 5

SHEET TITLE / TASK	Proj. Mgr.	Proj. Engr.	Des. Engr.	CAAD Tech	QA/QC	TOTAL
DIRECT LABOR RATE	$58.52	$51.20				$52.06
BRIDGE INSPECTION ASSISTANCE	16	120				
TOTAL HOURS	16	120	0	0	0	136.00
DIRECT LABOR	**$936.32**	**$6,144.00**	**$0.00**	**$0.00**	**$0.00**	**$7,080.32**

DIRECT EXPENSES FOR BRIDGE INSPECTION ASSISTANCE - Amendment 5

ITEM	QUANTITY	UNIT	UNIT COST	COST
LOCAL MILEAGE	100	Miles	$0.45	$45.00
LONG DISTANCE TRAVEL	2	Trip	$2,000.00	$4,000.00
BLACKLINE PRINTS		Copy		
PHOTOGRAPHY	100	Photo	$0.300	$30.00
DIRECT EXPENSES				$4,075.00

COST FOR BRIDGE INSPECTION ASSISTANCE - Amendment 5

Direct Labor	$7,080.32
Overhead at 120.53%	$8,533.91
Fixed Fee @ 12%	$1,873.71
Direct Expenses	*$4,075.00*
Total Contract Amount	**$21,562.94**

TOTAL AMENDED CONTRACT COST

	Previous Contract	Amendment No. 5	Revised Amounts
Labor	$229,290.38	$7,080.32	**$236,370.70**
Overhead	$296,146.24	$8,533.91	**$304,680.15**
Fixed Fee	$61,478.63	$1,873.71	**$63,352.34**
Direct Expense	$27,362.50	$4,075.00	**$31,437.50**
Total Cost	$614,277.75	$21,562.94	**$635,840.69**

Exhibit C-5
Invoice

INVOICE NO.______

To: Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard, St. Paul, Minnesota 55155

Estimated Completion: ______%
(from Column 6 Progress Report)

Copy: Scott Pierson, Project Manager
Minnesota Department of Transportation
Bridge Office, Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

Period Ending: ____________
Invoice Date: ____________

Re: Mn/DOT Contract No. 85907
Contract Expiration Date: ~~March 30, 2007~~ **March 30, 2008**
Project Description: Evaluation of Bridge No. 9340 (I-35W over Mississippi River)
SP Number: 2783-9340 TH Number: 35W

	Total Contract Amount	Total Billing to Date	Amount Previously Billed	Billed This Invoice
1. Direct Labor Costs: (See Exhibit B-5 for Breakdown)	$226,370.70			
2. Overhead Costs: Rate = 130.26% and 127.00% and 124.53% and 124.06% and 120.53% (Salary*Overhead Rate)	$304,680.15			
3. Fixed Fee (Profit) Costs: Rate = 12.00%, 10.00%, 10.00%, 12.00% and 12.00% (Fixed Fee = $ * Percent Complete)	$ 63,352.34			
4. Direct Expense Costs: (Attach Supporting Documentation)	$ 31,437.50			
Net Earnings Totals:	**$635,840.69**			
			Total Amount Due This Invoice:	

Activity Code	Total Billing to Date	Amount Previously Billed	Billed This Invoice
N/A			
N/A			
N/A			
Total*			

*Must Match Net Earnings Totals Above

For Consultant Services Use Only

I certify that the above statement is correct and payment has not been received.

Signature: ____________

Print Name: ____________

Title: ____________

Billing Address: **URS, Inc.**
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Telephone: **(612) 370-0070**

Approved for Payment: ____________

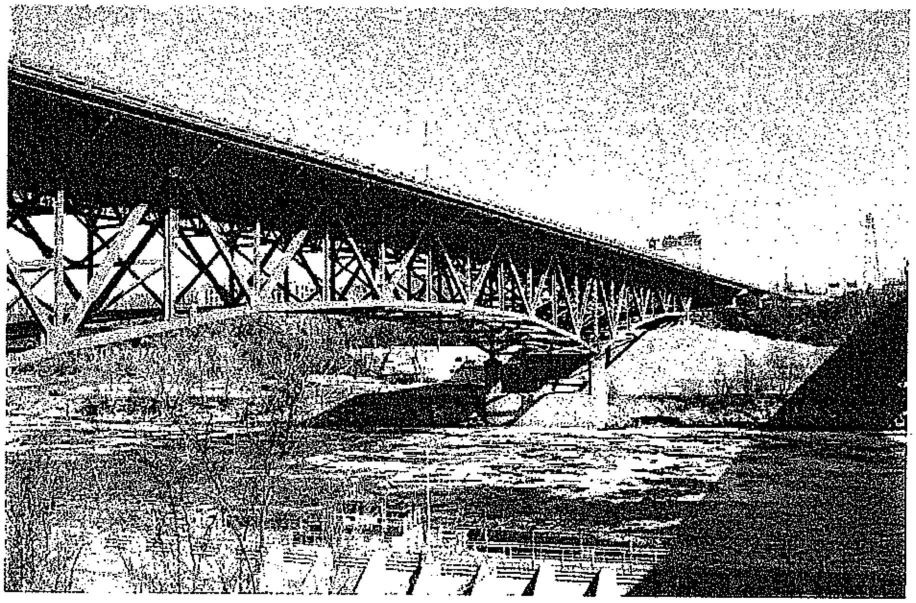
Date: ____________

(CSS Reviewed 1/26/2007)

DRAFT REPORT

FATIGUE EVALUATION AND REDUNDANCY ANALYSIS

BRIDGE NO. 9340
I-35W OVER MISSISSIPPI RIVER



Prepared for
Mn/DOT

July, 2006

URS Corporation
700 South Third Street, Suit 600
Minneapolis, MN 55416
Project No. 31809166.01201

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EXECUTIVE SUMMARY

Introduction

Bridge 9340, I-35W over the Mississippi River, is a three-span continuous deck truss for the main crossing. Built in 1967, the steel superstructure contains a number of fatigue susceptible details in the main truss members and floor truss members. Most pronounced are the welded attachments at the diaphragms inside the box section of the main truss tension chords, which are Category D fatigue details according to current AASHTO fatigue provisions. The bridge was designed in accordance with the 1961 AASHO *Standard Specifications for Highway Bridges*, which was based on a completely different fatigue design method that was revamped in the 1974 interim edition. The poor fatigue details on the truss spans, particularly those inside the main truss tension chords that are difficult to inspect, have raised concerns on the consequence of a possible main truss member failure triggered by a fatigue crack.

URS Corporation was retained by Minnesota Department of Transportation (Mn/DOT) to evaluate the integrity of the truss-arch superstructure in light of fatigue and fracture characteristics. The results from this study will be utilized by Mn/DOT as a reference for the development of future renovation work to be performed on the bridge. The primary objectives of the project include: (1) identify critical superstructure members that are most susceptible to cracking, (2) evaluate structural consequences if one of the critical members should sever, in terms of load redistribution and load carrying capacities of remaining members, (3) develop contingency repairs to selected fracture critical members, and (4) establish measures for improving structural redundancy and minimizing tensile stresses in the trusses, and develop a preferred deck replacement staging plan.

Computer Modeling

A 3-D finite element model was developed that includes all the structural components of the truss spans: deck, stringers, floor beams, floor trusses, main trusses, as well as all bracing members. All the piers and the adjacent approach span at each end were also included in the model. All steel components were modeled with space frame members through their center of gravity lines. Link members of proper stiffness properties were used at the joints to address the eccentricities due to the actual dimensions of members and connections. The reinforced concrete deck, with the existing transverse and longitudinal expansion joints, was modeled with shell elements at its mid-thickness and connected to supporting stringers with rigid shear link members for the composite action. Based on field inspection and measurements, the main truss expansion bearings have been found not to behave as intended and the actual force-displacement relationship of the bearings is rather erratic. In the computer modeling, two extreme bearing conditions were investigated for their impact: (1) the "as-designed" condition based on the original contract plans; and (2) the fully "locked" condition. Additionally, the stringers also have expansion shoes at certain locations on the supporting floor trusses. Both the "as-designed" and "locked" conditions were considered for these expansion shoes in the computer modeling.

The model was compared with previous strain gage test results of the bridge by University of Minnesota for truss member stresses under known loading conditions. Adjustments were made to the model for various support and connection stiffness properties to achieve a reasonable agreement with the test results. Based on the model-test comparison and a calibration process, the following conditions of the computer model were determined to yield the best prediction of truss member axial forces: (1) all main truss expansion bearings were completely fixed at the piers for the live load, different from the "as-designed" condition; (2) the substructure was included for the stiffness of all piers and their foundations; (3) all stringer expansion bearings were completely fixed at the floor truss and end floor beam locations, also different from the "as-designed" condition; (4) the link members at the stringer-to-floor truss and floor truss-to-main truss connections had a longitudinal stiffness that reflects the low out-of-plane web stiffness of the floor truss top chord and the actual connection properties; and (5) the link members at the deck-to-stringer and stringer-to-floor truss connections had a transverse stiffness that reflects the low out-of-plane web stiffness of the stringer and the actual connection properties.

Strength Evaluation of Truss Members

The strength of the truss members were evaluated using the 3-D computer model in terms of the force interaction ratio, defined as the sum of the ratios of force to section capacity for axial force and bending moments in two principal directions, considering the axial force and bending moments. This is different from the traditional design of truss bridges when only the axial force is considered.

Truss members of Bridge 9340 were originally designed using the axial force only with member capacities determined from the 1961 AASHO *Standard Specifications for Highway Bridges*. A "design ratio", defined for comparison purposes as the ratio of the calculated axial force under design load to the allowable axial capacity of the member, was used to measure the axial force design margin, similar to the force interaction ratio concept for combined force effects. Based on the information in the original contract plans, the design ratio was found to range between 0.730 and 1.004 for all the main truss members. This indicates that some of the members were sized very tightly in terms of the axial capacity and any bending moments would likely cause a localized overstress in relation to the design criteria.

Does this indicate underdesigned?

Since truss members of Bridge 9340 were connected as frame members in reality, they are subject to axial force as well as in-plane and out-of-plane bending moments. To measure the combined force effects, the force interaction ratio was calculated for all truss members based on member force results of 3-D analysis as well as section capacities determined per the 1985 AASHTO *Guide Specifications for Strength Design of Truss Bridges (Load Factor Design)* and the 2004 AASHTO *LRFD Bridge Design Specifications*, respectively. The calculation of the force interaction ratios included the loads due to camber, non-composite dead load, composite dead load, and live load.

Question if the members were fabricated to achieve cambered position – is the assumption correct.

The cambering of the main trusses and floor trusses was included in the computer model as a uniform axial member distortion load to account for the built-in forces this process would induce. The calculated vertical deflections of the trusses due to camber were compared with the camber diagram in the original contract drawings and excellent agreement was observed. Ideally, the truss member bending moments due to the total dead loads would cancel out those due to the camber and the truss members would be subject to axial forces only under the dead load. The 3-D analysis indicated that after applying the camber and all the dead loads, including those at the truss ends that support the approach spans, significant bending moments may still remain in some truss members although the bending moments due to camber do counteract with those from dead loads in most members.

The force interaction ratio under the total load (camber, dead load and maximum live load) was calculated for three cases: 1) unfactored load and ultimate capacity; 2) LFD factored load and ultimate capacity; and 3) LRFD factored load and capacity. For all truss members, the LRFD loading was found to produce highest magnitudes of the force interaction ratio. For the "as-designed" truss bearing condition, the maximum values of the interaction ratio are: upper chords 1.452 (U1'-U0'), lower chords 1.120 (L8-L9), diagonals 1.773 (U0-L1), and verticals 1.321 (U1'-L1'). The maximum values of the force interaction ratio for the "locked" bearing condition (for live load) are: upper chords 1.504 (U1'-U0'), lower chords 1.264 (L8-L9), diagonals 1.827 (U0-L1), and verticals 1.310 (U1-L1). One distinct feature of the LRFD loading is the inclusion of both truck and lane loads as compared with the LFD loading that uses the higher of truck or lane load. The analysis indicated that using the unfactored loads and the ultimate capacities, no truss member has a force interaction ratio exceeding 1.0.

Further investigation was made for truss members with force interaction ratios greater than 1.0 using the LFD and LRFD criteria. It was found that for all the cases considered, the axial component of the force interaction ratio is either less than 1.0 or slightly above 1.0 (1.039 maximum). This indicates that if the truss were evaluated based on the design assumption that the members take axial load only, the members would be acceptable. A comparison between the force interaction ratios of the same members under the LRFD and the LFD criteria indicates that the LRFD produces higher interaction ratios for all but two of the sections, or 98% of the members. This indicates the impact of the heavier LRFD loading. In diagonal member L1'-U0' the force interaction ratio per the LRFD was found to be almost 30% greater than that per the LFD. For the two sections where the LFD produces a higher interaction ratio, the value was only about 5% greater than the LRFD interaction ratio (U1-L1) and the magnitude was low. The highest force interaction ratio occurred in member U0-L1, the diagonal supporting the truss cantilever at the end of the truss spans. Using the LRFD criteria the total force interaction ratio was calculated to be 1.858 with 1.038 from axial, 0.819 from in-plane bending, and essentially zero from out-of-plane bending. A large portion of this axial load and in-plane bending can be directly attributed to the approach span loads that are applied at the upper joint U0. For the same member (U0-L1) using the LFD criteria the total interaction ratio was 1.464 with 0.871 from axial, 0.590 from in-plane bending, and essentially zero from out-of-plane bending.

A force interaction ratio greater than or equal to 1.0 for the existing structure does not necessarily indicate a member "failure", but rather a localized overstress beyond the elastic limit under the factored design load and section capacities. Besides, the occurrence of a local yielding in a structural system there typically is a load redistribution, and thus a reduction of loading forces at the overstressed section, based on the change of member/connection stiffness properties. It is important to note that no interaction ratios greater than 1.0 were observed in the analysis using the unfactored load and the ultimate capacity. This indicates that the actual design load should not cause overstress in any truss members. No signs of overstress have been reported in the service history of the bridge for more than 40 years. Although some members exhibited large interaction ratios using the LRFD criteria, this is mainly because the LRFD loading can be significantly greater than the original design load for some members. Another difference between the current analysis and the original design is the assumption that the truss member end connections are rigid rather than "pinned". This assumption of rigid connections, although tending to maximize bending moments in the truss members, should better represent the actual truss joint condition.

Does this mean no S Factor

In summary, a close examination of the force interaction ratios indicates that bending effects are not negligible in truss members when the members are assembled with moment connections. Such bending effects become significant when there are special sources for concentrated forces, such as the truss span ends that serve as supports to the approach spans. Additionally, the LRFD loading was also found to produce more severe load effects than the traditional ASD and LFD design load, due to the use of combined truck and lane load as well as a greater vehicle impact. The 3-D analysis showed force interaction ratios greater than 1.0 in some member sections using the LRFD and LFD criteria. However, a force interaction ratio exceeding 1.0 does not necessarily indicate a section failure but rather a localized overstress under the factored load which should result in a consequent load reduction at the overstressed section due to a load redistribution.

Fatigue Evaluation of Truss Members

Using the 3-D computer model and the fatigue truck for live load stress analysis, the truss members were determined to have infinite fatigue life in accordance with the AASHTO *Guide Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges* (LRFR Manual) and the *Guide Specifications for Fatigue Evaluation of Existing Steel Bridges* (Fatigue Guide Specifications). The University of Minnesota also concluded that fatigue cracking is not expected in the deck truss of this bridge based on field strain measurements and load tests in 2001. Therefore, it can be concluded that the probability for fatigue crack development at the concerned Category D details is very remote.

However, the fatigue concern should not be completely discounted for the following reasons: (1) the access to the fatigue susceptible details inside the truss sections is very limited for crack inspection at the weld toes and therefore a timely discovery is unlikely to happen should a crack occur for some unusual causes; (2) the length of the welded tabs at the box section diaphragms was specified 3.5" in length in the original contract plans, which is very close to the lower limit of 4" for the Category E detail. Should a fabrication error or the workmanship modify the detail to the extent that it has the fatigue resistance of a Category E detail, the infinite fatigue life requirement would not be satisfied per the AASHTO Fatigue Guide Specifications; (3) the traffic on the bridge is heavy compared with the average highway bridge and therefore the use of a single fatigue truck may be underestimating the repetitive load effects on the structure.

Structural Redundancy Analysis

For the investigation of structural redundancy and retrofit need, eight critical main truss members were selected from one half of each truss. The eight members actually represent thirty-two main truss members due to the nearly double symmetry of the trusses. Using the 3-D computer model calibrated with field testing results, the selection of the eight truss members was based on the following criteria: (1) subject to tension under combined dead load and live load; (2) containing the fatigue susceptible welded details at the interior diaphragm; and (3) among members subject to the highest magnitude of fatigue load stress range. The eight truss members selected based on these criteria are: L3-U4, L1-L2, U0-U1, U4-U5, U3-U4, L4-L5, L12-L13, and L13-L14. They cover all truss member types except the vertical, because the verticals are either compression members or do not have the fatigue susceptible detail.

The redundancy analysis was to evaluate the structural consequence for the sudden failure of each of the eight critical truss members, using the calibrated computer model. Based on the conventional planar analysis method used in truss bridge design, most tension truss members would be classified as fracture critical due to the statically determinant nature of trusses. The primary objective of the redundancy analysis was to assess the three-dimensional bridge structural system's ability to redistribute the load upon failure of a main truss member, considering the participation of all structural components. The force effects of load redistribution after a sudden member failure were to be calculated and compared with load carrying capacities of the remaining members.

After a literature review on structural redundancy evaluation, an analysis procedure was established to evaluate the force effects for the sudden failure of a main truss member and compare them with the load carrying capacities of the remaining members. Four live load cases were used for the redundancy analysis, which intend to represent realistically possible loading conditions on the bridge: (1) dead load only without live load; (2) eight lanes of slow moving HS-20 truck load (without multiple presence factor or vehicle impact); (3) eight lanes of standstill HS-20 truck and lane load (without multiple presence factor or vehicle impact); and (4) the LRFD design load (seven lanes of HS-20 truck and lane load pushed to one side with a multiple presence factor of 0.65 and a dynamic load allowance of 33%).

For each live load case, the remaining bridge system (members and connections) were checked for their structural capacities against the consequent forces resulting from the sudden member failure. The member and connection capacities were checked using the force interaction ratio, including the effects of axial force and in-plane and out-of-plane bending moments for section capacities at the ultimate state. According to AASHTO specifications for connection design, the connections were designed with capacities between 75% and 100% of those of the main members, depending on the magnitude of design forces. The force interaction ratios were calculated both without and with a dynamic impact factor of 1.854 applied to magnify the static results to account for the dynamic effects caused by a sudden member failure. The calculated force interaction ratio presents a measurement of the load effects in terms of the ultimate capacities, or the probability of a section failure, at either the member or the connection.

Results of the redundancy analysis include the following items: (1) number of consequent main truss member failures; (2) number of consequent floor truss member failures; (3) impact on the floor truss members that "failed" in the intact structural condition; (4) consequent impact on reactions at the expansion bearings; and (5) consequent maximum bridge deflections. Table 1 and Table 2 present results of the redundancy analysis for all eight members under each of the four live load cases, based on member capacities and connection capacities, respectively.

Table 1. Consequent Main Truss Member Failures due to a Critical Member Failure (Based on Member Capacities)

Number of Consequent Member Failures - Member Capacities					
Critical Member	Dynamic Impact	Load Case 1	Load Case 2	Load Case 3	Load Case 4
L3-U4 (Diagonal)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L1-L2 (Lower Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	1	0
U0-U1 (Upper Chord)	w/o Dynamic Impact	2	2	2	2
	w/ Dynamic Impact	3	4	6	4
U4-U5 (Upper Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
U4'-U3' (Upper Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L4-L5 (Lower Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L12-L13 (Lower Chord)	w/o Dynamic Impact	0	2	4	3
	w/ Dynamic Impact	2	3	7	5
L13-L14 (Lower Chord)	w/o Dynamic Impact	0	4	7	6
	w/ Dynamic Impact	6	7	10	7

Need
Truss
Diagram
to
understand

So
Exec
Summary
can
Standalone

Table 2. Consequent Main Truss Member Failures due to a Critical Member Failure (Based on Connection Capacities)

Number of Consequent Member Failures - Connection Capacities					
Critical Member	Dynamic Impact	Load Case 1	Load Case 2	Load Case 3	Load Case 4
L3-U4 (Diagonal)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L1-L2 (Lower Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	2	1
U0-U1 (Upper Chord)	w/o Dynamic Impact	2	2	3	2
	w/ Dynamic Impact	4	5	6	5
U4-U5 (Upper Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	1	0
U4'-U3' (Upper Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L4-L5 (Lower Chord)	w/o Dynamic Impact	0	0	0	0
	w/ Dynamic Impact	0	0	0	0
L12-L13 (Lower Chord)	w/o Dynamic Impact	1	2	5	3
	w/ Dynamic Impact	3	5	9	6
L13-L14 (Lower Chord)	w/o Dynamic Impact	0	4	9	6
	w/ Dynamic Impact	6	7	11	7

The tables summarize the number of additional main truss members that would fail as a result of the failure of the critical member both without and with the application of the dynamic impact factor. As shown in the tables, five of the eight critical members are fracture critical, i.e., their failure would result in the failure of at least one other main truss member and thus cause instability of the structural system. and possible collapse. The five fracture critical main truss members are: Lower Chord L1-L2, Upper Chord U0-U1, Upper Chord U4-U5, Lower Chord L12-L13, and Lower Chord L13-L14. These five members actually represent twenty main truss members due to the nearly double symmetry of the trusses. Accounting for the connection capacities yields more total consequent main truss member failures, but Upper Chord U4-U5 is the only additional facture critical member that would not be considered as such if the connection capacities were neglected.

Collapse?? ?

If so, say so. We need to note repeat to obtain action.

Retrofit Concepts for Improving Structural Safety and Performance

For strengthening the eight critical truss members on one half of each truss, several retrofit alternatives have been investigated, including the use of Carbon Fiber Reinforced Polymer (CFRP) strips or sheets, pre-tensioned steel strands or CFRP bars, and high performance steel plating. The general objective of the retrofit is to replace the strength of a member in an event that the member should completely fail due to a fracture initiated from the concerned fatigue susceptible detail. The added benefit is that the retrofit would also reduce the live load stresses and thus retard or minimize the development of fatigue cracks in the repaired members.

The steel plating concept was considered most suitable for this application and is recommended. The retrofit involves installing steel plates on the exterior surfaces of both webs of the truss member, with high strength anchor bolts properly located beyond the fatigue susceptible details. The retrofit steel plates, and the bolted connections at both ends, were designed to take over all the member forces and replace the lost capacity in the case of a member fracture. To minimize the plate weight for field erection and installation, high performance steel of 100 ksi yield strength was used with two steel plates on each side of the truss member with each plate width equal to approximately one half of the member web depth. Preliminary plans have been developed for the thirty-two truss members on the bridge.

an additional

So as not to assume it is an alternative

Another retrofit strategy is to alter the structural system by replacing the existing deck with a new deck that is continuous throughout the main truss spans and composite with the truss system. This structural alteration aims to reduce live load stresses in most members and improve structural redundancy. Combined with the steel plating member retrofit for selected critical members, the structural performance and redundancy of the redecked bridge is further improved.

Analyses results from the computer model indicate that replacing the existing deck with a continuous deck of the same thickness throughout the truss spans significantly reduces stresses in most truss members under both dead and live loads. The largest stress reductions typically occur in the members near the existing deck joint locations. Some truss members near the span contra-flexural areas experience minor stress increases due to a continuous deck under both the dead and live loads, but the consequence is not detrimental since those member forces are of low magnitudes. Under live load, further stress reduction can be achieved by using a thicker structural deck and by stiffening the connections between the floor truss and the main truss. The further stress reduction due to each of these two measures, however, is insignificant to the upper chords and nearly negligible to the lower chords and diagonals. Therefore, further enhancement of the deck-truss composite action by stiffening the connections between the main truss and floor truss top chord does not seem to be worthwhile.

The casting procedure of the new deck is critical to achieving the maximum benefit of stress reduction in truss members. Since the weight of wet concrete is carried by the steel system alone and any dead load applied after the deck concrete cures is carried more efficiently by the composite deck-truss system, the design and construction of the new deck should aim to minimize the thickness of the initial pour. For example, casting a continuous new deck with a 7" structural thickness plus a subsequently applied 2" overlay is more advantageous than a monolithically poured deck of 9" thickness. In addition, the use of light-weight concrete for the new deck should also be evaluated in the final design of deck replacement.

The impact of a continuous deck on the improvement of structural redundancy was also investigated using the 3-D computer model. The analyses indicated that replacing the existing deck with a continuous deck of the same thickness improves the structural redundancy by reducing the number of consequent member failures after the failure of truss lower chord L13-L14, and the failure of truss upper chord U7-U8, respectively. However, the continuous deck would likely not eliminate the consequent failures of main truss members and thus would likely not change the fracture-critical nature of either member. The amount of longitudinal deck reinforcement above Piers 6 and 7 shall be carefully determined in the final design of deck replacement.

A what is meant here
elaborate

While the condition of the expansion bearings was assumed locked under live load, both "as-designed" and "locked" conditions were considered in the redecking dead load analysis for their uncertain and erratic nature. The analysis results indicated that the effect of bearing condition is complicated and can be significant on truss member forces. In the final design of deck replacement, both bearing conditions should be taken into consideration and the governing situation to be used in the design.

Conceptual Plan for Deck Replacement

A conceptual plan for deck replacement was studied to maintain a minimum of four lanes open to traffic during construction and to minimize traffic interruptions during necessary transportation and placement of construction materials and equipment. Based on the layout of existing bridge ramps, it is easier to replace the half deck width on the east side and then the other half on the west side, or vice versa, resulting in unbalanced loading about the bridge centerline during the deck replacement construction. It is also possible, although more difficult, to maintain traffic for the outer lanes and then the inner lanes, or vice versa, during the deck replacement to keep balanced dead loading to the trusses.

Since truss bridges have generally been designed with symmetrical dead load between the two trusses, the suitability of the structure, particularly the floor trusses, to the transversely unbalanced half-deck loading condition was investigated. Using the LRFD design load on the 3-D computer model, the analysis indicated that member forces in the main trusses and the floor trusses are no higher in the half-deck condition than the full-deck condition. Therefore, the removal of half of the deck does not create a worse loading condition than what the existing structure is currently experiencing. However, it is likely that the original design of the floor trusses (members and connections) and other lateral bracing members did not consider the 3-D behavior of the truss system under transversely unbalanced half-deck loading. If the unbalanced half-deck procedure is to be considered, a more complete detailed analysis should be performed in the final design to evaluate the impact on all transverse members and their connections between the two main trusses.

Key question left unanswered

Based on the total available space between the existing side curbs of the bridge, it was determined possible to allow the maintenance of four traffic lanes in each of the two half-deck construction stages while having the median area serving as a path for transporting concrete. Using the 3-D computer model, a map of deck longitudinal axial stress contours was provided over the entire truss bridge, which can be used as a basis to determine the sequence of deck concrete pouring for placing concrete in the compression areas first and tension areas last. The exact sequence will depend on the volume capacity for each pour as well as traffic maintenance details.

What is urgency? Sequencing, can you wait for deck replacement.

Reiterate type of fatigue probability while failure low, should retrofit due to no inspection

Recommendations

Based on results of our study, the following recommendations are made:

(1) Five main truss members in one half of each truss, representing twenty members in the bridge, have been identified as fracture critical and should be retrofitted with the steel plating scheme developed, using high performance steel and high strength bolts. The retrofit, although not changing the fracture critical nature of the truss member, adds internal redundancy to the member and eliminates the possibility of a member fracture due to the fatigue of susceptible welded details at the internal diaphragms.

(2) Before the retrofit takes place, the fatigue susceptible details at the internal diaphragms inside the identified fracture critical truss tension chords should be inspected with the access hole cover plates removed during the normal inspections. The toe of the

Is this possible

Camera access, is NOT

If not possible Any

longitudinal fillet weld between the tab and the truss chord web is a primary location for the development of a fatigue crack.

(3) A deck replacement with a new deck that is continuous throughout the main truss spans, and composite with the truss system, can significantly reduce live load stresses in most truss members and improve the redundancy of the truss system. To minimize dead load stresses, the replacement deck should be placed in two stages, with a structural deck of minimum required thickness, plus an overlay. Alternatively, the use of light-weight concrete for the new deck can also reduce dead load effects and should be evaluated in the final design of the deck replacement.

Need to answer this.

Major question

(4) A preliminary analysis using the LRFD design load indicated that member forces in the main trusses and the floor trusses are no higher in a transversely unbalanced half-deck condition than the full-deck condition. However, since truss bridges have generally been designed with symmetrical dead load between the two trusses, it is more desirable to keep this symmetrical loading condition during deck replacement as much as possible. If the unbalanced half-deck procedure is to be considered, a more complete detailed analysis should be performed in the final design to evaluate the impact on all transverse members and their connections between the two main trusses.

(5) Based on a map of the deck longitudinal axial stress contours provided, the sequence of deck concrete pouring can be determined for placing concrete in the compression areas first and tension areas last.

8/13/06 – DLD

Comments on Executive Summary – Bridge 9340 Study

Strength Evaluation Page 5: The second paragraph notes that no interaction ratios greater than 1.0 were found using the unfactored load and the ultimate capacity. Assuming some were close to 1.0, does this mean no traditional safety factor remains and there is no residual capacity beyond the design live loads?

Fatigue Evaluation Page 9: Various members are described in the text and tables, such as U0)-U1 Upper Chord, etc. Within the Executive Summary, if would be beneficial to have a truss diagram. At times, only the Executive Summary would be reprinted for others to read. It should stand alone without needed the full report to clarify.

Fatigue Evaluation Page 10: The last paragraph states failure of five of the eight critical members would "cause instability of the structural system". For others in Mn/DOT that are not knowledgeable in structures this phrase may not be understood. If the conclusion is the instability would likely lead to collapse of the bridge, that should be stated clearly.

Retrofit Concepts Page 11: The first paragraph begins with; "Another retrofit strategy…" and discusses replacing the existing deck with a continuous deck. Some may conclude this is an alternate to the steel plating strategy. Suggest the sentence begin with: "In addition to the steel plating concept, replacing the existing deck…..etc."

Retrofit Concepts Page 12: The paragraph at the top of the page ends with the sentence; "The amount of longitudinal deck reinforcement above Piers 6 and 7 shall be carefully determined in the final design of deck replacements." What specifically is the writer thinking when this caution is given to a future designer. Please elaborate on the aspects you believe the designer must consider.

Conceptual Plan for Deck Replacement Page 13: The last sentence of the first paragraph notes if the unbalanced half deck procedure is considered, a detailed analysis should be performed during final design. This decision is critical to our future project planning. One of the outcomes expected from the study was an assessment of the redecking options and traffic maintenance. We need this key question answered at this time, how many lanes can be maintained and what should be the staging, either half at a time, middle rebuilt first, or outside redecked first? This same issue appears is Recommendation 4. Without this answer, the staging for the entire project and roadway is stalled. So it cannot wait for final design.

Recommendations Page 13: Within the recommendations, the summary of the fatigue life should be reiterated. In short, it appears the likelihood of a fatigue failure is low. However, due to the lack of access in the box members, crack initiation or growth cannot be monitored. Therefore, if a crack occurs, it could easily go undetected and result in a sudden failure. For those reasons, a retrofit is recommended.

Additionally, we should discuss the timing of the retrofit, urgency, and agree upon language for the Executive Summary. A natural question will be when these retrofits are needed and can they coincide with other work.

Recommendation 2 states an internal inspection should be conducted of critical members. Is it even possible to get an inspector within arms length of the internal diaphragms? If only camera access is possible this leaves no opportunity to clean away rust scale and perform the necessary NDT.

(Bridge 9340 Study Comments DLD 8-2006.doc)

Section 1 Executive summary 8/7/06 GDP

Page 1 first paragraph. - is anything known about toughness of the steel used. Some discussion of unknown toughness may bear on rate of crack growth and time to react to initial crack discovery.

Strength Evaluation

Page 3 2nd paragraph. What was the allowable stress for steel tension or compression members compared to yield. Is the last sentence true that with a design ration of 1.004 any bending moments would likely cause localized overstress in relation to operating or inventory bridge rating criteria. Clarification give us some feeling for remaining safety factors for occasional over legal loads.

Do we address what the operating rating of this bridge is based on the analysis? Based on what we know, we may want some discussion about permitting trucks somewhere between inventory and operating rating.

Page 4 center paragraph, 1st sentence: #) LRFD factored load and ultimate capacity???

In the following discussion, clarify that ultimate capacity is the yield capacity of the member.
The paragraph states the force interaction ratio for unfactored loads never exceeded 1.0.
What would be an acceptable interaction ration at an operating rating? How often is that interaction ratio exceeded?

Fatigue evaluation

Page 6 paragraph 1, first sentence: "determined to have theoretically infinite fatigue life"???

Retrofit concepts:

Page 10 last paragraph: For the plate retrofit option, was a computer model generated to determine if force effects are concentrated at the ends of the plate members? It seems the moment deformations might be magnified in the unplated axial member located between the last bolt in the gusset plate connection and the first bolt in stiffened axial member??

I may be mistaken but I thought the contract asked for some analysis of contingency repairs. There should be some discussion of using the retrofit concepts as contingency repairs, or others should be discussed in more detail. Perhaps they are in subsequent sections.

One concept discussed by the District is to purchase plates and bolts for one or two member repairs during the overlay contract to be installed as a repair should a short un repairable crack be discovered during inspections. Would one size plate work for any repair, assuming it would be cut to length in the future. Would it be possible to pre drill the plates in a pattern that would work for all without significantly reducing the strength of the plate if only the required bolts holes were filled?
Is it feasible to make emergency repairs a tension member under traffic, or from above the member, or would that repair need to be made from below. Is the repair feasible from below assuming the cracks may occur during winter months when barges may not be used?

Its likely that retrofit of main members may be postponed for 15-20 years once an overlay is placed next year. Indepth weld inspections would continue to made every 5 years on the critical members indicated in this report and a visual arms length inspection of the critical members would be made every year.

Section 1- Introduction

Page 1 last sentence: Category E not B

Section 2 Bridge Inspection and Data Collection

Page 6 first paragraph, first sentence: Do we really want a recommendation that specifically requires the tab welds to be inspected on a yearly basis. What is the basis for the recommendation.

An initial inspection schedule has been discussed that will open the access holes on identified critical members to do an up close inspection of tab welds every 5 years, and an arms length visual inspection of the exterior surface yearly, and a routine snooper visual inspection of all other tension members on a yearly basis.

Is the recommendation relevant to the scope of work of the study? Should it be deleted? If relevant, would it be sufficient to recommend that Mn/DOT establish an arms length visual inspection schedule for critical members to provide early detection of crack formation at tab welds.

Page 7 - Section 2.3.1. Is the reported crack in a critical, highly stressed, or fatigue prone member? **Metro**: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

Page 8 - Section 2.3.3 . Is the reported crack in a critical, highly stressed, or fatigue prone member? **Metro**: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

Page 9 - Section 2.3.6: was the transfer floor beam at the junction of the truss and approach span determined to be a critical member. Has retofit or freeing of these bearings been discussed or recommended in other sections. No recommendation concerning freeing these bearings is listed in the executive summary.

Page 23 last paragraph. - Good data. Does the fatigue analysis section discuss the significance of over 17 million fatigue cycles on the bridge. Does the number of cycles indicate that if flaws were present they should have caused cracking by now, and the absence of crack history or findings indicate a low probability of future cracking based on calculated fatigue stresses. Ie do we have some confidence that the absence of major flaws then increases the probability of infinite fatigue life?

Section 3 Computer Modeling of Truss Span

No comments

Section 4 Strength Evaluation of Truss Members

Page 2 Explain the that eq 4.1 is used for gross section calculations and 4.2 is used for net? Or what ever the difference is.

Page 4 bottom of page: is "this has been ..." a note that is meant to be deleted?

Page 19 bottom of page: is it LRFD factored load and ultimate capacity?

Section 1 Executive summary 8/14/06 GDP

Page 1 first paragraph. - is anything known about toughness of the steel used. Some discussion of unknown toughness may bear on rate of crack growth and time to react to initial crack discovery.

Strength Evaluation
Page 3 2nd paragraph. What was the allowable stress for steel tension or compression members compared to yield. Is the last sentence true that with a design ration of 1.004 any bending moments would likely cause localized overstress in relation to operating or inventory bridge rating criteria. Clarification give us some feeling for remaining safety factors for occasional over legal loads.

Do we address what the operating rating of this bridge is based on the analysis? Based on what we know, we may want some discussion about permitting trucks somewhere between inventory and operating rating.

Page 4, first paragraph: Have you confirmed from shop drawings that the bridge was actually built cambered to the theoretical no load condition?

Page 4 center paragraph, 1st sentence: #) LRFD factored load and <u>ultimate</u> capacity???

In the following discussion, clarify that ultimate capacity is the yield capacity of the member.
The paragraph states the force interaction ratio for unfactored loads never exceeded 1.0.
What would be an acceptable interaction ration at an operating rating? How often is that interaction ratio exceeded?

Fatigue evaluation
Page 6 paragraph 1, first sentence: "determined to have <u>theoretically</u> infinite fatigue life"???

Retrofit concepts:
Page 10 last paragraph: For the plate retrofit option, was a computer model generated to determine if force effects are concentrated at the ends of the plate members? It seems the moment deformations might be magnified in the unplated axial member located between the last bolt in the gusset plate connection and the first bolt in stiffened axial member??

I may be mistaken but I thought the contract asked for some analysis of contingency repairs. There should be some discussion of using the retrofit concepts as contingency repairs, or others should be discussed in more detail. Perhaps they are in subsequent sections.

One concept discussed by the District is to purchase plates and bolts for one or two member repairs during the overlay contract to be installed as a repair should a short un repairable crack be discovered during inspections. Would one size plate work for any repair, assuming it would be cut to length in the future. Would it be possible to pre drill the plates in a pattern that would work for all without significantly reducing the strength of the plate if only the required bolts holes were filled?
Is it feasible to make emergency repairs a tension member under traffic, or from above the member, or would that repair need to be made from below. Is the repair feasible from below assuming the cracks may occur during winter months when barges may not be used?

Its likely that retrofit of main members may be postponed for 15-20 years once an overlay is placed next year. Indepth weld inspections would continue to made every 5 years on the critical members indicated in this report and a visual arms length inspection of the critical members would be made every year.

Section 1- Introduction

Page 1 last sentence: Category E not B

Section 2 Bridge Inspection and Data Collection

Page 6 first paragraph, first sentence: Do we really want a recommendation that specifically requires the tab welds to be inspected on a yearly basis. What is the basis for the recommendation.

An initial inspection schedule has been discussed that will open the access holes on identified critical members to do an up close inspection of tab welds every 5 years, and an arms length visual inspection of the exterior surface yearly, and a routine snooper visual inspection of all other tension members on a yearly basis.

Is the recommendation relevant to the scope of work of the study? Should it be deleted? If relevant, would it be sufficient to recommend that Mn/DOT establish an arms length visual inspection schedule for critical members to provide early detection of crack formation at tab welds.

Page 7 - Section 2.3.1. Is the reported crack in a critical, highly stressed, or fatigue prone member? **Metro**: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

Page 8 - Section 2.3.3 . Is the reported crack in a critical, highly stressed, or fatigue prone member? **Metro**: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

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Page 19 bottom of page: is it LRFD factored load and ultimate capacity?

Section 5 Fatigue Evaluation of Truss Members

All AASHTO fatigue evaluations show theoretical infinite life

Section 5.5 Page 11 second paragraph: Some discussion of unknown toughness should be added to reasons for not discounting concern if cracks are present. Maybe some discussion of how toughness affects the speed of crack growth.

Section 6 Structural Redundancy Analysis

Section 6.1 Page 2 - Define CAFL and the significance that with three fatigue trucks the stress range for no no truss member significantly exceeds half of the CAFL

Section 6.4 page 9:
Informational comment: The discussion states that the NCHRP 406 analysis provides a comprehensive measure of bridge redundancy, from which persuadably some level of confidence or concern about a formation of a collapse mechanism could be concluded. Mn/DOT chose not to calculate this measure, and instead chose to assume members would fail, and then to consider the consequence of that failure.

It would informative to have run through that analysis. Does the consultant have a feeling for what that analysis would have shown? I assume due to the low stresses in the truss, the analysis would have shown the bridge had a high level of reliability.

Recommendations on Truss Members Retrofit

The following table lists the identified 13 fracture critical truss members on one half of each truss. Due to the double symmetry of the deck truss, there are a total of 52 fracture critical main truss members on the bridge structure. Figure 1 shows all the fracture critical members on one truss, or 26 members. These include the corresponding chord members on the opposing side of the zero-force vertical from the fracture critical members identified by the redundancy analysis.

Table. Infinite Fatigue Life Check of Fracture Critical Members on One Half of Each Truss

		Fatigue Guide Specs Fatigue Truck Method				*LRFR Manual* Fatigue Truck Method			
Truss Member	Dead Load Axial Stress	LL+I Stress Range S_r $I = 10\%$	Factored Stress Range R_sS_r	Limiting Stress Range S_{FL} Cat. D	Limiting Stress Range S_{FL} Cat. E	LL+I Stress Range Δf $I = 15\%$	Max Stress Range Factored $2.0R_s\Delta f$	Fatigue Threshold $(\Delta f)_{th}$ Cat. D	Fatigue Threshold $(\Delta f)_{th}$ Cat. E
	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)
L1-L2	1.50	1.53	2.58	2.60	1.60	1.63	3.10	7.00	4.50
L2-L3	1.50	1.42	2.38	2.60	1.60	1.51	2.86	7.00	4.50
U0-U1	9.76	1.19	2.00	2.60	1.60	1.30	2.48	7.00	4.50
U1-U2	8.54	0.68	1.15	2.60	1.60	0.74	1.41	7.00	4.50
U4-U5	11.61	1.17	1.97	2.60	1.60	1.25	2.37	7.00	4.50
U5-U6	10.95	1.16	1.95	2.60	1.60	1.24	2.35	7.00	4.50
L11-L12	15.73	0.71	1.20	2.60	1.60	0.75	1.42	7.00	4.50
L12-L13	15.73	0.71	1.19	2.60	1.60	0.75	1.42	7.00	4.50
L13-L14	17.54	0.58	0.97	2.60	1.60	0.61	1.16	7.00	4.50
U6-U7	18.06	0.38	0.65	2.60	1.60	0.41	0.78	7.00	4.50
U7-U8	18.58	0.43	0.73	2.60	1.60	0.46	0.88	7.00	4.50
U8-U9	17.45	0.36	0.61	2.60	1.60	0.39	0.74	7.00	4.50
U9-U10	17.33	0.34	0.58	2.60	1.60	0.36	0.69	7.00	4.50

The table also summarizes AASHTO criteria for infinite fatigue life check in accordance with the Fatigue Guide Specifications and the LRFR Manual using the fatigue truck method. The Fatigue Guide Specifications is more conservative than the LRFR Manual in that it applies a 1.75 reliability factor (vs. 1.0 in LRFR) to the calculated stress range due to the fatigue truck for fracture critical members and uses an infinite fatigue life limiting stress range of 0.367 times (vs. 0.5 times in LRFR) the constant amplitude fatigue threshold developed from fatigue tests. As shown in the table, all members satisfy the LRFR requirements for infinite fatigue life although the first six members fail to satisfy the Fatigue Guide Specifications for the Category E fatigue detail (U1-U2 is included in this group because of its counterpart U0-U1).

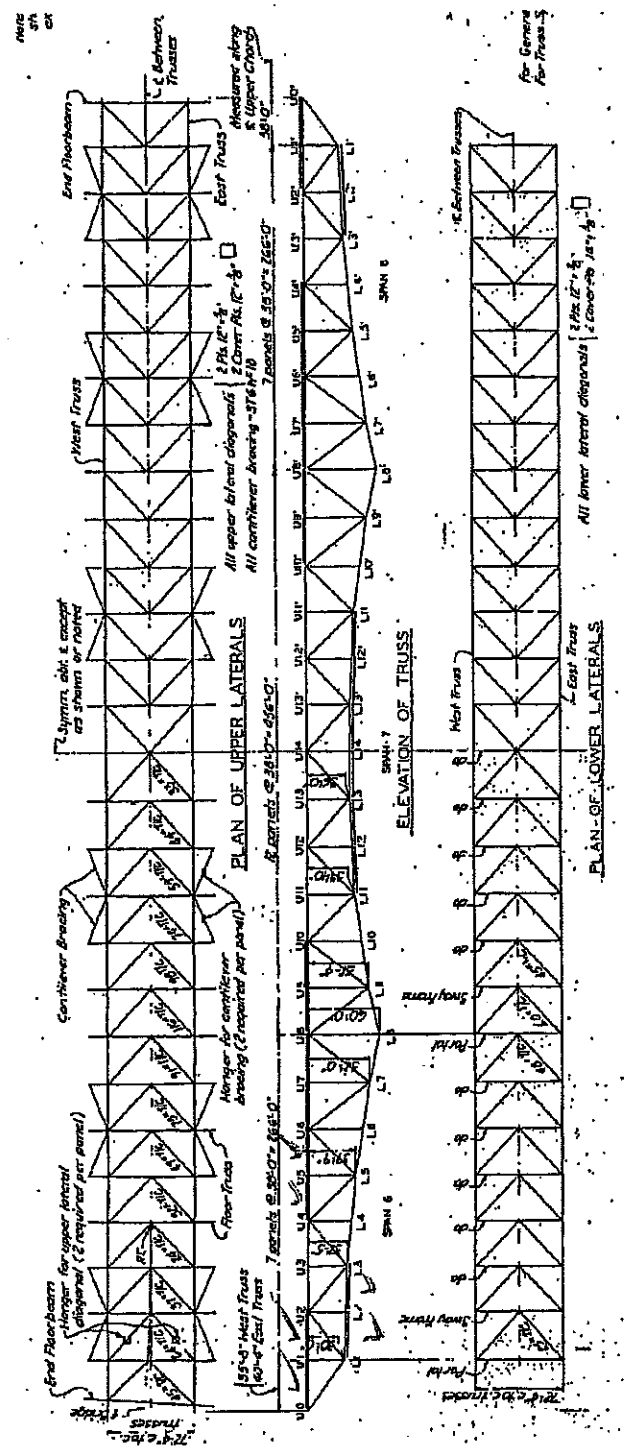

Figure 1: Deck Truss Framing Plan and Elevation from Original Contract Plans (Highlighted Members are Identified Fracture Critical Members)

The fracture critical members can be divided into two general groups: (1) relatively more fatigue sensitive members (L1-L2, L2-L3, U0-U1, U1-U2, U4-U5, and U5-U6), these members are subject to higher fatigue load stress ranges, not satisfying the Fatigue Guide Specifications' infinite fatigue life check for Category E, but are subjected to lower total stresses and have thinner web plates that are more forgiving for brittle fracture; and (2) relatively more fracture sensitive members (L11-L12, L12-L13, L13-L14, U6-U7, U7-U8, U8-U9, and U9-U10), these members have larger cross sections and are subject to very low fatigue load stress ranges, satisfying all AASHTO infinite fatigue life checks for Category E, but are subjected to higher total stresses and have thicker web plates that do not tolerate the existence of through-thickness cracks before the occurrence of brittle fracture.

It is very important to emphasize that neither a fatigue crack would propagate under repeated fluctuating load nor a brittle fracture would occur under some heavy load without a preexisting flaw or crack. As the results of a fracture mechanics analysis indicated in Section 9, the dimensions of preexisting cracks need to be quite large in order to propagate under the traffic load and grow to a critical size to induce a brittle fracture of the truss chord web plate. Since the locations of fatigue susceptible details are clearly known on Bridge 9340, one alternative retrofit approach to steel plating is to perform an in-depth non-destructive examination (NDE) of all the suspected details for existing cracks and flaws. For any weld-induced flaws or cracks discovered by the NDE efforts, a suitable procedure (e.g. grinding) should be carried out to remove the sources of localized stress concentration. After all the fracture critical members are assured of no existence of measurable cracks or flaws, confidence should be obtained for these members for infinite fatigue life under the traffic load.

Based on the analysis results described in this report, three equally viable retrofit approaches are recommended as follows:

(1) Steel plating of all 52 fracture critical truss members. This approach will provide member redundancy to each of the identified fracture critical members via additional plates bolted to the existing webs. The critical issue of this approach is to ensure that no new defects

are introduced to the existing web plates through the drilled holes. This approach is generally most conservative but its relatively high cost may not be justified by the actual levels of stresses the structure experiences.

(2) Non-destructive examination (NDE) and removal of all measurable defects at suspected weld details of all 52 fracture critical truss members. The critical issue of this approach is to ensure that no measurable defects are missed by the NDE efforts. The fracture mechanics analysis has indicated that the dimensions of preexisting surface cracks need to be at least one quarter of the web plate thickness in order to grow and subsequently cause member fracture under the traffic load. This approach is most cost efficient.

(3) A combination of the above two approaches: steel plating of the 24 more fatigue sensitive members (L1-L2, L2-L3, U0-U1, U1-U2, U4-U5, and U5-U6 in each half of each truss), and NDE of the 28 more fracture sensitive members (L11-L12, L12-L13, L13-L14, U6-U7, U7-U8, U8-U9, and U9-U10 in each half of each truss).

Brett McElwain/HuntValley/URSCorp
08/01/2007 03:34 PM

To Ed Zhou/HuntValley/URSCorp@URSCORP
cc
bcc
Subject Re: Section 4.3.1

Ed,

I think this issue is covered by the previous email. Please let me know if you need additional clarification.

Thanks,
Brett

Ed Zhou/HuntValley/URSCorp

Ed Zhou/HuntValley/URSCorp
07/31/2007 12:46 PM

To Brett McElwain/HuntValley/URSCorp@URSCORP
cc
Subject Section 4.3.1

I also have questions on how the live load design ratio was calculated using the alternating stresses as discussed in Section 4.3.1. Please call me to discuss.

----- Forwarded by Ed Zhou/HuntValley/URSCorp on 07/31/2007 12:44 PM -----

Ed Zhou/HuntValley/URSCorp
07/31/2007 12:00 PM

To Brett McElwain/HuntValley/URSCorp
cc
Subject Section 4.2.6

Brett,

I revised section 4.2.6 and would like you to review it. There are two things that I wanted to verify with you:

(1) the Original Design DL forces in the revised Table AII-5 are actual DL forces from an analysis, without any adjustment for alternating stresses or the 90% rule.
(2) The last paragraph in this section. Does it apply to DL?

Ed

Minnesota Department of Transportation

Office of Bridges and Structures
3485 Hadley Avenue North
Oakdale, MN 55128-3307

May 5, 2008

Office Tel: 651/366-4501
Fax: 651/366-4497

Mr. Robert Stein
Gray Plant Mooty
500 IDS Center
80 South Eighth Street
Minneapolis, MN 55402-3796

Dear Mr. Stein:

This letter is provided as a follow-up to the Legislative Hearing of April 11, 2008, and also an interview with Gray Plant Mooty attorneys on April 22, 2008. Kathryn Bergstrom of your staff has encouraged those interviewed to provide additional information or comments that we recall following those sessions. I am therefore responding to that offer.

Legislative Hearing Testimony by Gray Plant Mooty, April 11, 2008

On April 11, 2008, you provided testimony before the Joint Legislative Committee on the I-35W Bridge Collapse, representing Gray Plant and Mooty. I was in attendance that day.

During the course of that testimony several statements were made that require correction. Given the gravity of the I35W tragedy it is important that information supplied at legislative hearings be factual and in the proper context. Therefore, I am writing to you to hopefully ensure this same information is correctly stated at future hearings or in any reports generated by Gray Plant Mooty.

Among your statements you noted the Gray Plant Mooty is reviewing bridge safety issues and you stated; "We have begun to look in other areas, the collapse of a very similar bridge in Ohio some ten years earlier....what was learned here from that development". The bridge you were referencing is the Interstate 90 Bridge over the Grand River. Contrary to your testimony, the bridge did not collapse. The truss and deck sagged slightly. The bridge was repaired and continued in service.

Had there actually been a collapse of an Interstate Bridge of this scale we would have received information from the Federal Highway Administration or the American

Association of State Highway and Transportation Officials (AASHTO). We informed Gray Plant Mooty well before the April 11th Legislative Hearing that Mn/DOT received no information regarding the Ohio incident prior to August 1, 2007. That information was provided to Gray Plant Mooty in response to your Second Request for Documents Item No. 14. Unfortunately your subsequent testimony may leave members of the Legislative Committee wondering why Mn/DOT did not take action when another bridge supposedly collapsed.

Additionally, the incidents are quite different regarding the cause. In your testimony you referenced the National Transportation Safety Board Safety Recommendation (NTSB) that Gray Plant Mooty has reviewed. NTSB released that information on January 15, 2008, noting there was a serious error in the design of the gusset plates of the I35W Bridge with a result that "these gusset plates were roughly half the thickness required". The Ohio incident was caused by corrosion where the gussets had actual holes rusted through.

During your testimony you also stated the I35W Bridge's original design was "one which was obsolete almost after it was built – that design was no longer used nationally or in Minnesota for much time after its construction." It is true that the use of truss bridges declined sharply after the 1960's. The cause needs to be placed in the proper context. Truss designs have seen declining use in the last forty years in large part due to economics. The cost of material and labor associated with steel production, truss fabrication and erection caused owners to choose other bridge types. Your testimony referring to obsolescence may have mistakenly been taken to mean that truss bridges are unsafe. It is correct that Mn/DOT has not built a truss since 1987, but that is our choice due to the cost of construction, long-term maintenance costs, and our preference for redundant structures. Trusses are still occasionally built by other states, the most recent of which I am aware is the Mark Twain Bridge in Hannibal, Missouri, on Interstate 72 completed in 2000.

Hopefully this information will be of assistance to you in completing an accurate work product.

Observations From The April 22, 2008 Interview

On April 22, 2008, I was interviewed by Ms. Bergstrom and Mr. Johnson of Gray Plant Mooty. I am providing these additional comments as a follow-up.

A considerable amount of interview time focused on the inspection report references to a gusset at panel point L11 on the east truss. In the 1993 report corrosion was noted and measured as 18" long and up to 3/16". Mr. Johnson incorrectly concluded that this amounted to between 30 to 40% section loss. In my testimony I recalled the L11 gusset plate was approximately 8'-6" long and ½" thick along the line referenced in the report. I noted the entire plate length needs to be taken into account to assess the section loss. I checked on the L11 dimension upon return to the office to confirm my recollection and found the actual plate length was 8'-5" (101"). Calculating using the measurements in the 1993 inspection report results in a section loss something less than 6.6% at that time.

The L11 gusset (along with U10) was one of two cited in the NTSB January report as being half the thickness required. Mr. Johnson and Ms. Bergstrom repeatedly focused their questions on this aspect of the bridge. I offer the observation that Mr. Johnson and Ms. Bergstrom are attempting to make judgments on bridge condition, inspector's actions, and speculating on the significance relative to the collapse. This is being done without the benefit of the NTSB final report, without the possession of any evidence, and without the requisite engineering expertise necessary for such work. All need to remember it is the purpose and responsibility of the NTSB investigation to determine the cause of the collapse and they have assembled the technical expertise to accomplish that task.

Sincerely,

Daniel Dorgan
State Bridge Engineer

Cc: Senator Murphy
Representative Lieder
Commissioner Sorel

MARK PRIBULA INTERVIEW

JANUARY 7, 2008

MR. NOBLES: This interview is being conducted and recorded by the Office of the Legislative Auditor at the Roseville office of the Minnesota Department of Transportation.

Today's date is January the 7th, 2008, the time is approximately 8:55 a.m.

My name is James Nobles, I'm the Legislative Auditor for the State of Minnesota.

Deb and Mark, will you now identify yourselves for the tape, give your name and your employment positions? Mark.

MR. PRIBULA: My name is Mark Pribula. I work for the Minnesota Department of Transportation, I'm the metro district bridge safety inspection engineer. My specialty is what we call fracture critical bridge safety inspections. I'm a registered engineer.

MS. JUNOD: I'm Deborah Parker Junod, project manager with the Minnesota Office of the Legislative Auditor.

MR. NOBLES: Thank you.

Mark, before we get started, I want to just state for the record that we are conducting a legally authorized review under Minnesota Statutes 3.978, subdivision two, which requires you to give

us your full cooperation and to share with us all information, regardless of classification, and to fully and truthfully answer our questions.

We are not going to swear you in, but the same requirements do apply under the statute. If you prefer, we can swear you in. But I'd like to just proceed on the basis that you understand your legal obligation to fully cooperate and answer our questions fully and truthfully.

Is that your understanding?

MR. PRIBULA: That's my understanding.

MR. NOBLES: And your statements to us will become part of our workpapers and will be public when we release our report, unless you ask for and we grant a not public classification to any of your statements. So if at any point you wish us to make that not public classification, you need to ask for it and we need to grant it. Otherwise, everything that you say here and that's recorded and that will be transcribed will become public.

Do you have any questions about the process?

MR. PRIBULA: I've never done this before. So you're going to ask a lot of questions and I don't know what to ask about it, I guess.

MR. NOBLES: Okay. Deb, why don't you get started.

MS. JUNOD: This is the third meeting that I've had like this, so I have a couple of objectives today.

Overall, this evaluation is actually pretty broad. We're doing a lot of other work that's not related specifically to 35W or the bridge inspection process, so we've done some analysis on funding for the transportation system, in particular the state trunk highway system, revenues, expenditures. We're looking at pavement condition trend data over a 10-year period, bridge condition trend data over a 10-year period.

We have different pieces of work also going on about the decision-making process. Basically, what to do, how districts decide what to do when, in terms of trunk highway construction, bridge maintenance, pavement maintenance.

So this -- and bridge inspection is just one piece of a much larger evaluation that we have going on.

But legislators did have specific questions for us having to do with how the inspection process works. Who are the inspectors in

Minnesota, how were they certified, how many do we have, what's the work load like for bridge inspection. Questions specific to what happens after an inspection is finished. How do districts use the inspection reports and translate those findings in to work maintenance or contract work on bridges. And how does the district follow up to make sure that, you know, that the key things from an inspection report actually got fixed or addressed.

So those are actually the questions I want to talk about today. And what I did was I picked a couple of bridges in Minnesota to use as an example. 'Cause I think it's easier to talk about something concrete to deal with those issues, rather than just talking about them in the abstract.

So I've been over to District 3 and we talked about the Trunk Highway 23 bridge over the Mississippi there. And they just took me through their reports, and we just talked through -- to help me understand, when I look at an inspection report, what's a big deal, what is a lesser deal, in terms of an inspection finding. To get the story of the bridge, basically. And then we talked about what kind of work the district had done on that bridge

and what kinds of things had been deferred and why.

And then we had the same conversation on Friday, I think it was Friday, last week. I was down in Rochester and we worked through another example of a bridge down there.

So I'd like to use the same format here, just to have you walk me through the most recent -- the 2006 --

MR. PRIBULA: Yes.

MS. JUNOD: -- report. And just talk to me about what the findings were in this report, what kinds of stuff had been repeated and/or was related to maintenance that had been deferred, maybe, or were things just under watch, that there were no maintenance issues at all, I should put it that way.

And so I can just understand what's the story on this bridge from your perspective as an inspector, and then we can use that as a springboard to talk about how the district evaluates inspections after they're finished, decides what to do, what to defer, what simply needs to be monitored because that's prudent and fine.

Sound good?

MR. PRIBULA: Okay.

MS. JUNOD: So you have the report right

in front of you.

Let's start -- and it's so hard. I have a basic understanding. I'm not an engineer, so you need to be talking in layperson terms for us.

MR. PRIBULA: I'll try.

MS. JUNOD: You will try the best you can.

MR. PRIBULA: If you have questions, please ask.

MS. JUNOD: Absolutely. I will do that.

Let's just start, if you could walk me through, let's go to probably the recommendation page, I think.

Is this a smart place to start, in terms of an overview of 9340 and --

MR. PRIBULA: Sure.

MS. JUNOD: Yeah? Okay.

MR. PRIBULA: If you want to start there, okay.

MS. JUNOD: Let's start there.

Okay. At the top there's a series of long-term repair recommendations. And it looks here like the inspection team thought the bridge ought to be replaced, rather than redecked, is the preference. And if the bridge replacement is

significantly delayed, then it should be redecked in the meantime.

And just talk to me a little bit about the long-term expectations from your team.

MR. PRIBULA: The reason that we say replace for that type of structure, if you look at the picture on the title you'll see it's all one truss underneath.

MS. JUNOD: Okay.

MR. PRIBULA: Typically, even though on that bridge, if you ever went across it, you saw the mid -- the median barrier, that had a cap on it, the bridge actually -- the structure below it was all one piece.

MS. JUNOD: Okay.

MR. PRIBULA: Unlike Lafayette, unlike the new 35E bridge, they are separate, separate bridges.

MS. JUNOD: Um-hum.

MR. PRIBULA: This one is all one piece, as I've said. You have to -- to redeck it becomes a little more of an engineering problem.

MS. JUNOD: Okay.

MR. PRIBULA: 'Cause you have -- you unbalance the loads on the deck if you take it off in half.

MS. JUNOD: Okay.

MR. PRIBULA: Engineering-wise there's structural considerations you have to consider in doing it. You can do it, it just becomes a little -- a lot trickier.

MS. JUNOD: Okay.

MR. PRIBULA: You know, there are a lot of things that you do for this type of structure. The other thing for replacement is it becomes a problem because you can't cut the bridge in half and replace one -- build one-half new and then replace the other half. So it's a catch 22 in a way for that type of construction on both ends, deck replacement or complete replacement of the bridge.

MS. JUNOD: Okay.

MR. PRIBULA: We -- my inspectors have wrote these recommendations. We're talking about the -- the replacement on a long print size, because we know the traffic are always are getting heavier and heavier in this area, and on all the bridges in the metro, or all the system in the metro, not just the bridges.

We also, they also have, on this bridge there are several what we call fracture critical --

MS. JUNOD: Fracture critical.

MR. PRIBULA: This bridge is fracture critical, there are some inherent problems, details that they designed in sixty -- I can't remember when offhand, I think this was put up in '67.

MS. JUNOD: That sounds about right.

MR. PRIBULA: And they didn't at that time understand fatigue fully, and so they did -- they did some manufacturing methods and design methods that we don't build in our new bridges right now.

MS. JUNOD: Right.

MR. PRIBULA: So that's why we have, in the first bullet there, of the fatigue configuration of the cross beam, with the cracking on the approach spans and such.

MS. JUNOD: So replacement would be pretty extensive because --

MR. PRIBULA: That is not -- I can't make that call, 'cause I -- my job within the department is to -- is inspection safety engineer.

MS. JUNOD: Okay.

MR. PRIBULA: I can recommend to say this is time, you know, five years, 10 years down the line, 20 years down the line, we may want to start thinking about either redeck or replacement. I cannot walk in and say no. I do not have -- one, I do not have the authority, that's not my job.

I can make recommendations or a finding saying that, you know, in my experience and such, I know this deck is -- is deteriorating at this rate, and in 10 years we're going to have to either redeck completely, do what we call a low slump overlay, do a limited service overlay, do a mill and patch, is where you see the guys jackhammering.

MS. JUNOD: Right.

MR. PRIBULA: You know, in known pads, you have different areas of just you go down just to the rebar, which is a -- and I can't remember this, type three and type two.

MS. JUNOD: Okay.

MR. PRIBULA: One is you go all the way through the deck and you put underpinning underneath and you completely take that concrete out, the other one you just go down to the first layer, just below the first layer of the reinforcement.

MS. JUNOD: Okay.

MR. PRIBULA: And so the whole series of recommendations or things that I can talk about, along with my peers, this is not a solo effort.

MS. JUNOD: Sure. It would play into the discussion about --

MR. PRIBULA: It would play into the discussion.

MS. JUNOD: Okay.

MR. NOBLES: Mark, could I just ask, though, is there something about the design itself that would say to you, because as you just said, the design itself creates problems in redecking, in replacement, so it is, as you said, a catch 22. Is that in and of itself a reason for you to say at some point we need to replace this bridge because it's such a pain to deal with, even though it may have useful life left?

MR. PRIBULA: To answer your question, we are looking -- we don't look at it as a pain to deal with, we look at it as a -- from an engineering viewpoint. It is the structural -- are the structural problems becoming -- the problems that are there, are the problems serious in nature, are we going back out there and trying to fix them, or we have a problem.

Because this meets the definition of fracture critical on this type of structure, are these, you know, is it going to affect the safety of the traveling public. And the long-term is we look -- and we were looking at -- looking at it, we said, you know, this is part of it, we knew we were going to be having to replace it completely in, I think, 2040, was one plan, don't quote me for sure on that date, but I know that's why we were doing some work on the joints and the deck last August.

MS. JUNOD: Right.

MR. PRIBULA: That was what we come up with.

Now, for the actual safety of the bridge and stuff like that, if we found a bad enough member, we would close the bridge. End of story. We would just put the trucks right across right there in the noon rush. It's, you know, we have the authority just to block the bridge off. And if the public is, you know, we're on the phone and we explain our reasons, we then talk to CO bridge, the state bridge engineer, and there's several people that work with him, saying this is why we're closing it, then that sets off a whole different chain that we go down. And I can be agreed with or I can be overruled and then they will open the bridge back up.

MS. JUNOD: But you felt comfortable, at

any time you've always felt --

MR. PRIBULA: I felt comfortable with the bridge.

MS. JUNOD: -- you at least felt comfortable also, that you felt comfortable with the bridge, that's part one; part two, if you hadn't felt comfortable, you had no qualms about it.

MR. PRIBULA: Yes. The reason why I say that is, you know, if we find serious problems, and I'll describe one as in the first bullet there, we're talking about the fatigue cracking in the approach spans.

MS. JUNOD: Um-hum.

MR. PRIBULA: And the fancy term, or not the fancy term, but engineering term for that approach span, cracking is out of plain bending. Now, approach spans usually are multigirders.

MS. JUNOD: Okay.

MR. PRIBULA: So they have, instead of one there are two main girders. They have -- it's just like a simple highway bridge, so you see a whole series of girders. As an engineer, if one was to crack, the load path transfers to the other two.

MS. JUNOD: Okay.

MR. PRIBULA: I mean, it is serious, but

the bridge will still stay. This type of bridge that we have here, if that's the worst case -- the worst case scenario, I'm going to paraphrase it, is if that member were to fail, the bridge would collapse. And it's a tension number by ASH codes, which is one of our codes.

MS. JUNOD: Right.

MR. PRIBULA: On the approach spans, is we went in, and this is also why we always have two guys in super buckets, one is for safety and the other is two sets of eyes, we went into the approach span area and we looked, and which you are looking for, and this bridge is 1,900 feet long, approximately, and basically you're looking for a -- if you have a red coat, or you have a red threaded palm, that's what the cracks look like on a green paint. So that's what you're looking for.

MS. JUNOD: Okay.

MR. PRIBULA: And at this point they had a -- the diaphragm connects the girder, and the diaphragm basically locks the two girders together.

MS. JUNOD: Okay.

MR. PRIBULA: What happens is, as the vehicles go down, the girder bends down this way, the flex. There is always the flex, that's why if

you're out on the deck with us and you get all -- the new people get spooked about it, they are always deflecting. If we built them without deflection they would fatigue and fail faster.

MS. JUNOD: They're supposed to move.

MR. PRIBULA: They're supposed to move. But what happened is that this -- in this area these diaphragms were what we call negative moment region, which is the tension -- the compression tension forces are reversed. And so it's -- but what happened was the girder would bend down like this, but the diaphragm would want to pull this way.

MS. JUNOD: Okay.

MR. PRIBULA: And then the web, which is your I, your vertical on the I-beam, would want to pull out. And this is a welded connection, which is the -- on a new bridge it would be bolted, it's looser. These were welded and welded completely around.

MS. JUNOD: Okay.

MR. PRIBULA: The technology leads into fatigue problems. And basically the diaphragm is pulling the -- tearing the web right out. And this -- this was a problem. And we found that and immediately we stopped our inspection, went back and looked through the entire span that we were in, on one, then we started the haystack approach and we looked in each negative moment region on the approach spans and we found more.

MR. NOBLES: Mark, could you just specify the time period you're discussing?

MR. PRIBULA: That was like '99, '98. And then they repaired it via the contract we had in 1998 -- 1999 for repair. That was a type of -- when we find something like that, we usually will call, we notify. On that level of seriousness, 'cause we had approximately 30 locations on this, and you have 22 girders across on the approach spans, and we have 30. We had 11 in one spot, and you had another 15 in another area, and on both approach spans, north and south. And we said we have problems, let's go, you know, you guys, we were talking to CO bridge, can you please come on out. And we had an immediate response from CO bridge, our construction and maintenance engineer out there. And we were discussing what we had and everything else. But that's the type of -- that's a normal occurrence.

Now, for the routine one, we would not call, you know, that gentleman out.

MS. JUNOD: But this was an example,

then --

MR. PRIBULA: This was an example.

MS. JUNOD: -- where the inspectors found something serious, a serious finding on the bridge, and what happens. You called people out right away, and then the repairs for these issues --

MR. PRIBULA: We had --

MS. JUNOD: -- were listed, what we see here for the 1999 repairs were mentioned in several places.

MR. PRIBULA: Yes.

MS. JUNOD: Throughout the report. So that's --

MR. PRIBULA: And, basically, and the other thing is we were always monitoring those areas. What you did, the repair, is you -- we lower the diaphragm, we cut -- we had the choice of either having our own forces do it or contract it.

MS. JUNOD: Okay.

MR. PRIBULA: We chose -- we, by management, chose to lower the diaphragms via contract, the paying contract, and some other work they had in 1999.

MS. JUNOD: Okay.

MR. PRIBULA: They lowered the diaphragm

to down, getting it out of that tension area up on top, dropped her down, and loosened up and put bolts in. And they only put like two bolts or three bolts in the connection. And they also drill out the cracking on top, which means you drill or leave holes there.

MS. JUNOD: Okay.

MR. NOBLES: Again, just to be clear, Mark, you're speaking from your personal involvement of that bridge at that time?

MR. PRIBULA: Yes.

MR. NOBLES: And what was your position at that time?

MR. PRIBULA: I was in the same, I've been in the same job since 1997.

MR. NOBLES: Okay. So you were directly a part of those discussions?

MR. PRIBULA: I was the guy who found -- one of the guys who found the cracks, yes.

MR. NOBLES: What consideration was given at that time to stopping traffic on the bridge?

MR. PRIBULA: It was an approach span, we were okay without -- with it. It was -- engineering judgment, within my experience, you can let the traffic run on it, it'll be all right.

MR. NOBLES: During that time --

MR. PRIBULA: We did consider it, but when they did repairs on it we moved the traffic off the lanes. When we dropped -- when they do the load beam and work like that we have to have traffic off of that lane.

MS. JUNOD: Okay. Have there been any instances since then? I mean, this sounds like one of the biggest findings on that bridge, in terms of inspection issues. Has anything else kind of risen to that same level since then?

MR. PRIBULA: No.

MS. JUNOD: No, okay. All right.

MR. NOBLES: Were you going to cover, Deb, the work that was being done?

MS. JUNOD: Sure. I figured --

MR. NOBLES: Okay.

MS. JUNOD: Let's go back to we were walking through here and we can keep going.

MR. NOBLES: I'm sorry for that comment.

MS. JUNOD: Oh, no, this is exactly how we want this to go. It should just be, you know --

MR. PRIBULA: I was trying to explain our procedures and how we do it.

MS. JUNOD: Exactly.

MR. PRIBULA: And usually I don't wear a tie.

MS. JUNOD: Oh, let's see.

Okay. So we were talking about the long-term nature of why, you know, replacement for this bridge would be important to consider.

MR. PRIBULA: Um-hum.

MS. JUNOD: And it says, if bridge replacement is significantly delayed, the bridge should be redecked. Let's see.

This bridge was actually in, I think, the bridge office plan for redecking consideration in 2015 to 2023. Is that kind of a reasonable time span, is that what you understood?

MR. PRIBULA: That's what I understood.

MS. JUNOD: Okay.

MR. PRIBULA: But we were doing a part of what we would just say an overlay on this one.

MS. JUNOD: Right, that's what was happening in '07, right?

MR. PRIBULA: Yes.

MS. JUNOD: Okay.

MR. PRIBULA: And an overlay can last 10 to 30 years. It just depends on what bridge you are on and where you are.

MS. JUNOD: Okay.

MR. PRIBULA: Usually a life of an overlay is about 20.

MS. JUNOD: Okay.

MR. PRIBULA: Approximately.

MS. JUNOD: Okay. My understanding from Dan Dorgan was -- or actually Gary Peterson, that they were still debating the redeck versus replacement --

MR. PRIBULA: Yes.

MS. JUNOD: -- issue, that was an active --

MR. PRIBULA: That was an active issue and, again, that is not germane to my information.

MS. JUNOD: Right.

MR. PRIBULA: I would give some information, but I was not in those discussions.

MS. JUNOD: Okay. Let's go down to the immediate maintenance recommendation bullets. And maybe you could just talk me through what each of these was about, how long is the -- just talk me through these.

MR. PRIBULA: First bullet, details of pigeon screens, dealing good pigeons dead. This is --

MS. JUNOD: You're the third person who said that to me.

MR. PRIBULA: A pigeon makes a nest in its own poop. Enough said when it's wet. I don't know if you people are from the farm or anything like that.

MR. NOBLES: We know pigeons.

MS. JUNOD: We've known pigeons.

MR. PRIBULA: Yeah.

MS. JUNOD: Yuck.

MR. PRIBULA: Yeah. These members underneath the truss, if you look, again I'll refer you to a different picture, the tension and reversal members are built -- what we call built-up members, basically they are welded together plates and angles.

MS. JUNOD: Okay.

MR. PRIBULA: And that carries load within that area. But on that, on this particular bridge, the designers chose a oblong-type shape to cut up as openings within the members. One, to be able to see stuff; two, to cut weight.

The problem is that pigeons find those areas very, very nice and make all sorts of nests inside of them. We put covers on all those members

and the compression members to eliminate the problem. That's why we put them on there.

And then for -- every two years we remove the screens on the reversal, what we call reversal members.

MS. JUNOD: Okay.

MR. PRIBULA: That is a member that carries alternating compression and tension loads.

MS. JUNOD: Okay.

MR. PRIBULA: And the tension -- tension members needs to be removed, the members within those areas is they have, in the fabrication shops they, again, they didn't understand fatigue at the same time, but they took a -- when they built this up they take a rectangular plate, weld it together, and that holds everything together. And then they take angle tabs on each side.

MS. JUNOD: Okay.

MR. PRIBULA: Little four-by-four tabs and they weld them completely. Now, in a tension member that's a category of prime detail, which according to federal FHWA guidelines is the worse detail possible.

MS. JUNOD: Okay.

MR. PRIBULA: What our concerns is is

that under long-term loading, the beam tension all the time, fatigue cracks will develop.

MS. JUNOD: Okay.

MR. PRIBULA: Or the tack welds themselves, 'cause that's what they have, sets up stress concentrations because of the heat from the welding guns.

MS. JUNOD: Okay.

MR. PRIBULA: And you are under load and you induce cracking into the -- not so much -- you induce cracking into the weld, you induce -- what we're more concerned about is inducing that crack to transfer into the vertical member.

MS. JUNOD: The routing.

MR. PRIBULA: That's what we're concerned about.

MS. JUNOD: Okay.

MR. PRIBULA: And that's why we would remove the covers every two years, to visually inspect those features. And to visually inspect them we also used other equipment. One such that we use is what we call magnetic particle testing to determine the crack.

MS. JUNOD: Okay.

MR. PRIBULA: To identify if there are

any cracks there. If we had questions of how deep that crack was, we would either have to come back with a MnDOT ultrasonic technician.

MS. JUNOD: Okay.

MR. PRIBULA: With his equipment they can tell you -- they can tell how deep the crack is.

MS. JUNOD: Okay.

MR. PRIBULA: The other -- the other crack methodology that we use, that we used to use, is die penetrate, but that takes too long.

MS. JUNOD: Okay.

MR. PRIBULA: And we just don't have that kind of time to be out there, and it's too temperature sensitive.

MS. JUNOD: Okay. So on this bridge, though, in 2006, you used the magnetic --

MR. PRIBULA: We always had new buckets every year.

MS. JUNOD: Every year you do the magnetic testing.

MR. PRIBULA: Yep.

MS. JUNOD: In those --

MR. PRIBULA: We always had the equipment with us, but every two years we were inside those removing those covers and then --

MS. JUNOD: Okay.

MR. PRIBULA: -- we would look at it. If we had questions, were in doubt, check, was our philosophy. If you had a question, then it became a -- it became an exercise of how thin you are trying to get back into the -- into those members.

MS. JUNOD: You need the smallest person on the crew?

MR. PRIBULA: Yes. The skinniest guy usually won.

MS. JUNOD: Okay. And did you -- so you haven't had to call in ultrasonic testing on those members, do you remember, in the last year or two?

MR. PRIBULA: This may, as in part of anticipation for the -- what the paper is concerned about is we were doing an inspection in May. We were not doing an inspection in May on this bridge, we were scheduled to do our inspection in September.

MS. JUNOD: Right.

MR. NOBLES: When you just referred to the paper, what is that?

MR. PRIBULA: Star and Tribune.

MR. NOBLES: Okay.

MR. PRIBULA: And the Pioneer Press.

MR. NOBLES: Okay.

MR. PRIBULA: So what we were out doing with them, to address your question with ultrasonic testing, we were locating, specifically locating the diaphragms within the -- within the members. Because our shop drawings, we wanted to --

MS. JUNOD: Right.

MR. PRIBULA: -- locate those things exactly, because if we were going to go out and it go forward, at that time we were -- we were going to go forward with the structural retrofit.

MS. JUNOD: Um-hum.

MR. PRIBULA: We needed to know exactly where the diaphragms were for the bull holes. If we had to -- we had to field drill a lot of this stuff, we need to know, we didn't want to hit the diaphragm, be right there in the bull, in the wrong spot. That's what we were doing.

MS. JUNOD: That was in May, 2007.

MR. PRIBULA: 2007, yes.

MS. JUNOD: Okay.

MR. NOBLES: I want to just pause for a moment, and I don't want to interrupt your flow here --

MS. JUNOD: Go ahead.

MR. NOBLES: But I want to know

specifically from you, Mark, because you're the guy that knows a lot, and then you see what you've said, or what the document showed translated into media representations and articles in the Star Tribune and the Pioneer Press or wherever else.

I'd like to give you an opportunity to tell us, in what ways do you think those representations, articles in the media, had been either accurate or inaccurate? Created good impressions of what was going on or had been misleading in any way?

MR. PRIBULA: I think they've been generally inaccurate. My opinion only.

MR. NOBLES: That's what we're here to get.

MS. JUNOD: Yep.

MR. PRIBULA: The representations that we were inspecting the bridge in May are incorrect, they never got it. That was given by our public affairs and central office public affairs to the papers and they never put that down. It doesn't sell, my opinion.

For a long time I couldn't read the papers because I was so angry. They -- my wife would read them and I would reply back.

MR. NOBLES: Well, we don't have them in front of us, but, I mean, if you recall from your wife's reading them to you, or interpreting them to you, if there's anything else specifically that comes to mind that you think has been misleading, I'd really appreciate you correcting that.

MR. PRIBULA: That particular scene, that we were out inspecting the bridge, we'd already inspected it, no, we were not inspecting it. They were given the schedules, they were told by Dan Dorgan and Gary Peterson when we were going to be out there as metro. And metro, our district staff has also made the same comments to the reporters.

They called my house, for crying out loud. You know. It's fair game here, you don't get to terrorize my family. And when the bridge came down that's what they ended up doing. And I have young children, and I know this is on tape, and they were very scared about it.

And that would be the main thing. The inaccuracy of the level of reporting. They're selling papers. It was not malicious, it was not malfeasance, they're not -- we did our job, we did it right, no one wants to believe us.

MR. NOBLES: Okay. Go ahead.

MS. JUNOD: So the last -- this inspection is June 2006, right?

MR. PRIBULA: Right.

MS. JUNOD: And then your next one was schedule for September.

MR. PRIBULA: September. We typically --

MS. JUNOD: The normal process --

MR. PRIBULA: Normal process. When we do -- we do construction, construction is its own group, we are in maintenance.

MS. JUNOD: Right.

MR. PRIBULA: We want to stay away from construction because it interferes with their job, and they will stay away from us when they're doing -- when we are doing our job. Sometimes, if it's possible, we will try to maximize the lane closures out there.

MS. JUNOD: Sure.

MR. PRIBULA: That's why if you've ever driven around and you go can they put any more equipment, you know, orange trucks out there on this bridge, that's the reason.

MS. JUNOD: So that's because there's an inspection crew there at the same time.

MR. PRIBULA: If they got a lane closed

for the week then we'll do it.

MS. JUNOD: Okay.

MR. PRIBULA: So we typically wait until the construction project is finished, or we get in there before they get done.

MS. JUNOD: Okay.

MR. PRIBULA: In this case we were waiting until they were going to be finished in September. And so it's a guess on our part, 'cause sometimes these things take longer, they get started late, you know, they find unexpected problems. Again, any construction project, you know, on any job, you always have some problem you didn't expect.

We were, like I said, we were scheduled to be out there in September, middle of September.

MS. JUNOD: Okay.

MR. PRIBULA: And the bridge fell down before we got out there.

MR. NOBLES: Again, I want you to be a little more specific for me about how these decisions get made up the chain, meaning you're focused on the bridge's safety.

MR. PRIBULA: Yeah.

MR. NOBLES: You have inspections, you write reports, and ultimately, though, who decides when something is going to be done in response? Who decides when and what is going to be done?

MR. PRIBULA: As in repairs or as in maintenance findings or inspection findings, if I find something out there or my crew finds something out there, is what you're asking?

MR. NOBLES: Um-hum.

MR. PRIBULA: Our procedures usually are, if it's a serious issue like I just talked about, then we are talking the central office bridge, I notify my supervisor, usually he is notified second, I notify the CO first.

MS. JUNOD: Okay.

MR. PRIBULA: Not because of the -- it's just I'm going for the -- for the expert in structures first.

MS. JUNOD: Right.

MR. PRIBULA: And then I'll notify my boss, hey, we got something out here, and then he'll be out here. You know, we're on Nextel so it's fairly easy for us.

MR. NOBLES: So could you just specify just, again, for the record, when you say your boss, you're speaking of whom?

MR. PRIBULA: Jack Pirkl.

MR. NOBLES: Okay. When does Dan Dorgan get involved?

MR. PRIBULA: That I can't say.

MR. NOBLES: Okay.

MR. PRIBULA: I would notify -- usually, the CO person I notify is Paul Kivisto.

MS. JUNOD: Right.

MR. PRIBULA: And then he is the metro region construction maintenance engineer. And then I will -- he will have somebody -- he will come out, and there may be a design engineer coming out also. There may be Gary Peterson, who is the construction and maintenance manager. He may come out, depending. We may have three -- I don't know who's coming out.

I do know Paul will be coming out, I don't know who else will be coming out. As to when the design and repairs and, you know, style and repair design methods, I can't address that. They will ask for input from us. They will design -- Paul, or one of the four designers, design squads, will have prepared a design sketch, then we will let it out for construction.

MR. NOBLES: What is your method of recourse if you believe things are not going up the

chain of command fast enough, or ultimately a wrong decision is made in terms of how to respond?

MR. PRIBULA: I've never had that problem.

MR. NOBLES: Okay.

MR. PRIBULA: But we have -- I am stubborn enough, and Jack knows it, that I will -- I will go ahead and go right up the chain.

MR. NOBLES: Who would you go to?

MR. PRIBULA: Dan Dorgan.

MR. NOBLES: Okay.

MS. JUNOD: So that's a serious level issue. More routinely, what happens?

MR. PRIBULA: Routine, if we find a -- to describe a routine crack, I mean, if you look in most reports you'll see some of the stuff like of one fatigue crack in a certain area. Well, we monitor it. It's the same thing as a leak on your house. It does not affect the structural integrity of the house, but we look at it and we keep an eye on it and we note it.

If it's growing, then we will say -- I will say, I'll talk to Phil, Phil Erickson is a maintenance supervisor, Jack Pirkl, I may talk to Paul about it, you know, or may or may not.

Again, it's engineering judgment. If it's one I don't know, you know, and there's some things with the loadings and the way the structural will move, and I'll go, okay, I always -- you always, in this industry, or profession, you err -- you get conservative. You -- if a beam is hit you shut the lane down that was hit underneath, even though you know it can hold the load, but you always move the traffic over just in case. You go on the other side.

So if I get confused or I have a question, you know, again, a what if, I need somebody to say, yeah, you did the right thing, you know, I'll call them up and say look this up or I'll e-mail. Or usually I'll call, it's a little faster.

If I can't get a response, if Paul is on vacation or something like that, I'll call. I know the other guys that are at Paul's level within the organization, so I'll talk to those guys.

MS. JUNOD: Paul Rowekamp.

MR. PRIBULA: Paul Rowekamp, those guys. But, you know, on minor repairs I will talk to mostly Phil. He's our bridge maintenance supervisor -- maintenance superintendent, I'm sorry. And then these are -- these are put into the -- they are then added to work order lists for the bridge. That's how it's supposed to work.

MS. JUNOD: So Phil is the one who will put stuff into the work order? Thank you. Okay.

MR. PRIBULA: He runs the crews, I do not run the crews. If we find something on the -- because the bridge crews provide traffic control for us, we just short-circuit it. You know, you guys got something here, we got one problem here, we'll step out and do it. You know, if it's short enough. The problem is we are in time windows, and we have to be off the road, we don't have a five-hour window, we have to be out of there. We can be out there just after the morning rush and we have to get off the road before the afternoon rush.

MS. JUNOD: Okay.

MR. NOBLES: So maintaining traffic flow is a big consideration?

MR. PRIBULA: For them, yes. We will push it. If we find something or if it's a question of can we be done in, say, a half hour, if we -- we're supposed to be off there at 2:30, can we push it till 3:00, and we don't have to come back the next day, they'll stay till 3:00.

MS. JUNOD: Okay.

MR. PRIBULA: Now, Y and P traffic anymore, it's a short term pain for a long term gain.

MR. NOBLES: Just one other question, then, and you can continue on here, Deb.

MS. JUNOD: Um-hum.

MR. NOBLES: Mark, is there anything in the history of this bridge, the 35W bridge that collapsed, that sticks out in your mind as something that you think should have been done that wasn't done, for whatever reason? Budget constraints, traffic flow issues. Was there enough flushing of the bridge because of the pigeon droppings and other things, salt? Is there anything that sticks out in your mind that you think, wow, we should be doing more of? You fill in the blank.

MR. PRIBULA: I don't think so. I think we did -- we did a -- could we have always done a better job? Yes, we could have.

MR. NOBLES: Specifically, how could you have done a better job?

MR. PRIBULA: Flushing, that type of stuff, basically. But you have to understand, our equipment needs, the bridge flushers are usually booked solid, and we would have to stop our

inspection for them to flush, and then they have to come back twice. Could we have done -- hindsight is always 20/20 on this collapse. What caused it, that's caused me a lot of sleepless nights. My PE is on the reports. You know, that's always there. I always wonder what triggered it to go. I don't know.

I think we did our job and we did the best job we did. What anything else to do, you know, if I would have had time travel, never build that type of structure, you know. And not that type of structure, but never build it out as one piece, is what I'm saying.

MS. JUNOD: Got you.

MR. PRIBULA: You know, you gave us no -- you gave us no room on how to rebuild it. And to say we had to rebuild or redeck, I mean, to build a new one to replace it with that in mind. I don't think that the designers in the late '60s ever anticipated the traffic loads that we have now. And that's -- that's a crystal ball and that we can never do.

We were given the deck that we had, I think we did a good job. You know, you are always going to have deterioration, we're always going to

have pigeons on it, the pigeon debris cannot cause a bridge to come down. The paint did not cause the bridge to come down. The de-icing system that we put in on that bridge did not cause the bridge to come down.

Everything that the Star and Tribune and the Pioneer Press said that caused the bridge to come down, it did not. Those three items. It did not cause it to come down. I don't know what caused it to come down.

Again, you're asking -- no, I think we did a good job. And, you know, it's -- we could always have done better if we had more money.

MS. JUNOD: That actually leads me into another area of conversation that I wanted this to spur. And that is, over time one of the themes the other districts have raised is maintenance budgets, operations budgets in general at the district level have gotten tighter and tighter. Has that been your experience --

MR. PRIBULA: Yes.

MS. JUNOD: -- here? So when you say that, you know, there's always deterioration on the bridges to keep up with, has metro been able to keep up with that?

MR. PRIBULA: As for the maintenance, I can't say that. I mean, yes, we deferred a lot of it, you see that in reports. It appears that we deferred a lot of it. Some of the bullets and stuff are more notes for us to monitor the areas.

MS. JUNOD: Okay.

MR. PRIBULA: We are making engineering judgment saying, okay, this is a -- as a nonengineer, Deb, you are -- you read the note and you go --

MS. JUNOD: Holy cow.

MR. PRIBULA: Holy cow. The other one is structurally deficient, and as a PR, or as an engineer, for a nonengineer seeing that phrase, yeah, we could have wrote it better. But to me it means is not -- the bridge is not deficient as in point of near collapse. It's deficient, and the rating system means we got to start planning to fix it. This is a flag saying we have to repair the bridge.

MS. JUNOD: Right.

MR. PRIBULA: The bridges are always going to be deteriorating. We have winter, we have salt put on the bridges. Unless the public wants to stop driving 80, you know, it's going to be that

way. You know, we try and do the best job we can. Maintenance budgets have been -- I believe have been reduced, even in metro. We have not reduced the level of inspections.

MS. JUNOD: Okay.

MR. PRIBULA: For the safety of the bridges. But we have had to, you know, in some cases, defer stuff because of the money.

MR. NOBLES: What stuff?

MR. PRIBULA: I can't say. Some of the basic. Some of the repairs, the monitoring.

MS. JUNOD: Would Phil be a good person to go to --

MR. PRIBULA: Phil would --

MS. JUNOD: -- to kind of what's in the work here, what's been deferred, would Phil have that?

MR. PRIBULA: I would think Phil would be better on that.

MS. JUNOD: Okay.

MR. PRIBULA: Some of it I was involved with a little bit. You know, can this -- you look at it and you go is this okay, yes.

MS. JUNOD: Okay.

MR. PRIBULA: In three years, you know,

you're trying to think -- when you look at it right at that moment in time you see a problem, then you have to -- you have to look and anticipate what's going to happen in, you know, the next year, or five years, or eight years, and, you know, can you live with that.

MS. JUNOD: Okay. So do you meet with Phil after each of the inspections, of this bridge in particular, and say other fracture criticals that you inspect, do you meet with him or do you just pass the report along? How does that communication go?

MR. PRIBULA: The reports are -- I would prepare reports for Jack, myself, Paul Kivisto, and Phil I'll skip. You know, I don't give them the whole report. You know, it's 80 pages and -- not 80, 60 pages, some were getting up to 100. We put a lot of pictures in them. For even us, when you try describing the gusset plate and the interconnects and the angles, in the paragraphs you have that description and you still go, what the heck.

MS. JUNOD: In this case a picture really is worth a thousand words?

MR. PRIBULA: Yes.

MS. JUNOD: Okay. So you prepare those

reports to --

MR. PRIBULA: And then I would give an executive -- try to give the executive summaries or verbal findings to Phil or Jack, and then annually I give the whole kit and caboodle to the CO on a CD.

MS. JUNOD: Okay.

MR. PRIBULA: It used to be zip drives, but now it's CDs.

MS. JUNOD: Okay.

MR. PRIBULA: And then we are always talking about, when we do repairs, we have a bridge improvement program.

MS. JUNOD: Right.

MR. PRIBULA: And Roger Schultz runs that, and then we are talking about it and, like, for case in point, that's how the spot painting on 9340 was derived.

MS. JUNOD: Okay.

MR. PRIBULA: That's how the -- some of our, you know, Mark, what do you anticipate for your fracture critical bridges, do you have some problems out there.

MS. JUNOD: Okay.

MR. PRIBULA: And you have to think, you know, we're in 2013 now, and this is 2007. It's like you have to sit there and think, okay, in 2007 this is a problem, is this -- can we then bring this forward. Bring it forward on an issue, anticipation of possible repair inclusion, in that year or sooner, or it can get pushed back a little bit.

MS. JUNOD: Okay. So you work with Roger then --

MR. PRIBULA: Yeah.

MS. JUNOD: -- in that way, in terms of a little bit longer term.

MR. PRIBULA: Yeah. We are always five years out.

MS. JUNOD: Five years out.

MR. PRIBULA: Yeah.

MS. JUNOD: Okay.

MR. PRIBULA: For planning.

MS. JUNOD: Was there anything from 9340 that you had talked in 2006 with Roger?

MR. PRIBULA: For bridge recommendations?

MS. JUNOD: Yeah, for recommendations.

MR. PRIBULA: For this project? Yeah. We will always, Jack, Phil, myself, we'll walk through the bridges, from the bridge recommendations, and we did walk through this one.

MS. JUNOD: Okay.

MR. PRIBULA: And looked at it and we found some, you know, as an engineer we would call them minor stuff to repair, in addition to the -- to what they're doing on the joints and stuff. We did the -- we are the ones saying can we get rid of the finger joints, and that's, again, it's a bad design because of all the salt leaches down in the floor beams and the trusses.

MS. JUNOD: Okay.

MR. NOBLES: So, Mark, do you want to just, for the record here, just tell us, then, a little bit about what was going on in terms of maintenance, repair, on the 35W bridge that collapsed when it collapsed?

MR. PRIBULA: It wasn't maintenance and repair, it was a contract --

MR. NOBLES: Just elaborate a little bit for the record again on what was going on.

MR. PRIBULA: They were doing -- and it's not really my area again. This is for the record. That they were doing what we call a low simple overlay on the deck, they were doing repairs to the joints, they were doing some repairs to the -- some of the bearings in some of the other areas in the future on the approach spans. Mainly the work is

the joint and deck repair. That's what they were working on. We had -- on the north side we had some problem delam areas, and we knew it, because when we found it, we just couldn't get out there and fix it, so that's what they were doing.

MR. NOBLES: And, again, just for clarification, was that work being done in response to bridge inspection reports?

MR. PRIBULA: Bridge inspection reports, bridge maintenance. Usually it's bridge maintenance will do soundings, and we had all that -- we gather all of this information and put it together that way.

MR. NOBLES: So there's been some suggestion that the work itself that was going on, and some of the loads on the bridge that resulted from that work, may have had some impact. I'm not asking you to pass a judgment on why the bridge collapsed, but I want to go back to something you said earlier, and that is that the design of this bridge itself creates some sort of tricky challenges in terms of doing a redecking, for example.

MR. PRIBULA: Um-hum.

MR. NOBLES: Because you've got to make sure your loads are properly distributed and traffic

is properly distributed. Were you involved specifically in those considerations in the work that was going on?

MR. PRIBULA: No.

MR. NOBLES: Who would have been?

MR. PRIBULA: I honestly don't know.

MR. NOBLES: Okay.

MR. PRIBULA: I honestly don't know.

MR. NOBLES: Do you have any concern about the loads that were put on that bridge during the work that was being done?

MR. PRIBULA: I can't comment on that because I never saw it.

MR. NOBLES: Okay.

MR. PRIBULA: I never saw the piles on the bridge. Again, we stay away from there.

MR. NOBLES: Deb was talking to you just a minute ago about sort of a planning process.

I want to specifically ask you, has the collapse of the 35W bridge had any impact on your process, of either in -- well, we know it's had on inspections because there was an accelerated set of inspections. But just beyond that, overall, given what happened, are you thinking about other bridges differently and approaching them differently?

MR. PRIBULA: Yes. We're going to be trying to implement some changes. Plus, I know more changes are coming at the federal level for their guidelines and stuff like that. What they are, I don't know yet.

There were changes implemented just before this collapse to do what we call in-depth inspections on these fracture critical bridges. It used to be every four years, now it's two. That was just -- that was starting up next year, I think.

As in for metro, we are kicking around different ideas of what we are going to do. Expanding the bridge unit, getting possibly, you know, this is very preliminary areas of getting a possible maintenance super doing maintenance work, if we have the money. Definitely changing the inspection procedures. Possibility of outsourcing some of it, possibility of outsourcing it to other districts so you get a different set of eyes coming in.

We always would switch where we started from last year, so like if I started on the north end, well, the next year that crew would start on the south end. The guys who are on the south end go to the north end, so you don't get familiar, too

familiar. But the problem, you know, I can see, in my opinion, it would be a nice idea for us to go up to Duluth, and District 6 also have fracture critical bridges, they come up here, we go down there, a different set of eyes, different opinions. Mostly it's a different set of eyes so we don't get complacent with the bridge. You are human, you get complacent. And, you know, you read the report, oh, it's the same thing from the year before, you know, you put somebody else up there who is new, going, oh, wow, you know, we got to do this. So that's being kicked around. As in, you know, getting more -- more assistance out there, different types, having other inspectors.

I have two key people, I will usually have one that I will borrow from CO bridge to make the fourth in my group. We probably will be changing that in the metro, adding a fourth guy here, or a girl. We don't have any women on the crew.

MS. JUNOD: I was just laughing. That fourth person.

MR. PRIBULA: You know, that type of stuff is what we're looking at right now. It will change even more than that.

MS. JUNOD: What about any differences in terms of communicating results of the inspection?

MR. PRIBULA: That will also -- that's also changing. Right now we are having -- we just developed a paper, one page, it's actually two pages, but, you know, who was at the meeting, when it was, who attended, what was the inspection findings, what was the significant findings, what are you going to do about it, what's the responsibility, do you contract it out. You know, little numbers below it, and we're going to probably start using that for the bridges.

MS. JUNOD: So a little more formal documentation.

MR. PRIBULA: More formal documentation than we have.

MS. JUNOD: I met with Bev a couple weeks ago and she was talking about --

MR. PRIBULA: We don't have that now and didn't have that before, and I think that's what we're finding, is we are a little -- a lot of it is by word of mouth so there's no written documentation. We talk to each other, we don't write everything down.

MS. JUNOD: Okay.

MR. PRIBULA: We're not good at that. We are out there such a short time, you see something, you go, can you take care of this, done. You know. That's basically the way we're set up.

MS. JUNOD: Okay. But moving forward you think there will be --

MR. PRIBULA: Moving forward there will probably be more formalized.

MS. JUNOD: More process.

MR. PRIBULA: More, a better paper trail.

MS. JUNOD: Okay. In District, gosh, what is it, District 3, I think, they're smaller, they don't have as many bridges, but they use an access database where the inspection findings actually get put into this work, the maintenance group's access database so they can track specifically what -- what were the major maintenance-related findings from the inspection and then what got scheduled and what didn't, that kind of thing. That does not exist here?

MR. PRIBULA: We're going to be doing that same thing, but we have, you know, we have 1,200 bridges.

MS. JUNOD: Your scale, the issues of scale, I understand.

MR. NOBLES: I'm going to have to change the tape.

MS. JUNOD: Okay.

MR. NOBLES: It is -- what is it, 9:56, and we're going to change the tape.

(End of Tape One.)

(Tape Two.)

MR. NOBLES: We are back on tape, it is 9 -- what did I say last time?

MS. JUNOD: It's 9:56.

MR. NOBLES: Okay.

MS. JUNOD: Still.

MR. NOBLES: We'll let that be it. Deb.

MS. JUNOD: Okay. So we were talking about what some of the changes, in procedure, mostly procedural changes it sounds like, that have arisen since the collapse of the bridge. And one of those is rethinking maybe who goes on the fracture critical inspections, which -- who's going to be on the team, perhaps switching to get some new eyes on --

MR. PRIBULA: Switching around. I think what the feds may come down with, for fracture critical, is they may have a requirement. We've been hearing rumors, and we thought about it too, is

have an engineer as a member of the team.

MS. JUNOD: Okay.

MR. PRIBULA: Typically, from what my experience is, with going to conferences and stuff, it's unusual that we have an engineer right on site.

MS. JUNOD: Okay.

MR. PRIBULA: We are not the norm. We are not the norm, the norm is to have inspectors who are not engineers. But what Parsons Brinckerhoff did, when we consulted with them, most of their inspectors were engineers. And so we -- that's one rule that we may be seeing from the federal FHWA, saying for fracture critical there would be an engineer as a member of the team. That could happen.

MS. JUNOD: Okay.

MR. PRIBULA: And I think that will happen, actually.

MS. JUNOD: And then the other issue -- idea that you raised was having another set of eyes, at least somebody new to the team.

MR. PRIBULA: Yeah.

MS. JUNOD: Coming on with a different perspective.

MR. PRIBULA: Or have a different

district come in to -- one thing I've suggested is to not to go outsourced, but to -- and I know that may also happen as a quality check also, but have another district come in and do our fracture critical bridges, and we go down there and do theirs, as the same thing, quality assurance.

MS. JUNOD: Okay.

MR. PRIBULA: It's a different set of eyes.

MS. JUNOD: Well, there's some advantage, though, to having the same set of eyes on a bridge over time, though, too, right? Because wouldn't you be able to look at that bridge and say, you know, that's different than last year?

MR. PRIBULA: Yes.

MS. JUNOD: That's an argument that's been raised to me, for keeping some continuity in the inspection.

MR. PRIBULA: It is, but if you read the reports, it's also in there. But then, you know, in some of these problem areas, these reports, you know, the thing is, you're dating the years. You sit there and you go, oh, this is growing, or it's one year, it'll be stopped, and there's no rhyme or reason why the pattern -- there's no pattern on a

lot of this stuff. Sometimes there is, sometimes you can figure it out. Sometimes, though, the pattern is not there.

MS. JUNOD: Okay.

MR. PRIBULA: It's a bridge. You have no idea why it's doing what it's doing. You know, if everything was wired, and sound, that's the other thing, is maybe we will be using the smarter technology. You know, using the data for inspection methods in, you know, determining crack problems and crack fatigue on a bridge. You know, that's new technology, it's still pretty much cutting edge. Some of the stuff is out there, like acoustic emission for cables, when the -- when the -- for the cable bridges, you know, they have technology in there that can tell you when the cable pops. When the strand pops, not the whole cable.

MS. JUNOD: No. One, yeah, of the millions --

MR. PRIBULA: Yeah.

MS. JUNOD: Yeah.

MR. PRIBULA: But the -- and we could use a variation on that on our bridges. But the thing is you have so much background noises in these bridges, and they make -- you know, if you're ever underneath there you think everything is quiet. On the deck you hear the roar of the traffic. The bridge is not quiet, it's always -- I mean, you always hear banging and movement and cracking and everything else, you have to filter that noise out. But there are other methods of determining a crack, or potential for cracks, but then you have to wire up each and every connection, and you have to have a data log, or you have to have somebody look at the data to analyze it. And, you know, it becomes that. But there is that out there. That technology is out there. And --

MS. JUNOD: In your opinion, have you had available to you -- I guess the kind of tried and true technology and techniques, is there anything that you haven't had available, in terms of equipment or technique?

MR. PRIBULA: No, we've always had access to the other stuff. Personally, I wish I understood a method called finite element better. I knew nothing about it. That's how you model the stresses within the structure. My personal thing, is that's what they did, that's what the U of M did in their study on this bridge.

MS. JUNOD: In 2001?

MR. PRIBULA: Yeah. They did a final element with extra. I wish I understood that better.

MS. JUNOD: Okay.

MR. PRIBULA: That I don't have. I didn't have that class in college.

MR. NOBLES: I'm glad you brought that up because I wanted to ask you about that. What was your understanding of the purpose of utilizing that technology at the University? And, specifically, was it to test the technology or to test the bridge?

MR. PRIBULA: Test the bridge. It is not to test the technology. We've had that -- that method of analysis has been around for a long time. It's a computer model that is a modeling of the connections, and you can load it so you can initiate fatigue failure on the bridge. URS did the same type of modeling for their reports in their 2003 report. That's why I said I wish I understood it better.

MS. JUNOD: Okay.

MR. PRIBULA: I didn't have it.

MR. NOBLES: But the department is obviously able to --

MR. PRIBULA: The department has the

people who have that, they already have the designers who understand that technology.

MR. NOBLES: Within the department or through contract?

MR. PRIBULA: Both.

MR. NOBLES: Okay.

MR. PRIBULA: Both. And that would be one thing. I lost my train of thought.

MS. JUNOD: You were talking about do you have available --

MR. PRIBULA: Oh, yeah. That would be the only thing.

MS. JUNOD: Okay.

MR. PRIBULA: The other technology, we have access to what we call ultrasonic testing via a consultant or our own forces within central office. We have our -- we have within our group visual inspection, and our experience plus our magnetic testing for a crack, I mean, particle testing for crack detection. We did use die penetrate, but in Minnesota, we -- in metro we stayed away from it because it's stinky. Oh, it just reeks. And it takes too long. It takes 45 minutes at perfect conditions to determine the crack. There's a lot of prep work to get it to work. Magnetic particle is a

lot faster.

MS. JUNOD: Do they test for the same basic things?

MR. PRIBULA: Yes.

MS. JUNOD: I mean, I understand the basics.

MR. PRIBULA: Okay.

MS. JUNOD: But --

MR. PRIBULA: They basically test for the same thing.

MS. JUNOD: Okay.

MR. PRIBULA: The same thing, the same results. The only thing is, both die penetrate and magnetic particle only tell you if there's a crack.

MS. JUNOD: All right.

MR. PRIBULA: It doesn't tell you the depth.

MS. JUNOD: That's what you use the ultrasonic for.

MR. PRIBULA: Ultrasonic or x-ray, and x-ray becomes a method of just getting the equipment and being exposed to x-ray, so ultrasonic is better.

MS. JUNOD: Okay.

MR. PRIBULA: You know, they use the x-rays on the -- on the -- for the welds in the shops, or like on the Alaska pipeline, or on a lot of the other structures where they can, you know, block it off, but not in the field.

MS. JUNOD: Have you ever had any difficulty getting access to the ultrasonic folks to get in when you need them?

MR. PRIBULA: Nope, just trying to schedule them, that's just logistics. That's just trying to coordinate with, they're busy, we're busy. Our season starts up in April and shuts down about end of October. Depending on the weather, it can be --

MS. JUNOD: Sure.

MR. PRIBULA: I've done bridges in the first part of November, which is not a whole lot of fun, because of rain delays. That's the problem. If we are pushed in the rain, I've done it in snow, once it was snowing out.

MS. JUNOD: Isn't that fun?

MR. PRIBULA: That's not so bad. It's when it's windy out, that's when it gets bad.

MS. JUNOD: I didn't get a chance to ride in a snooper, I was kind of hoping I could.

MR. PRIBULA: Probably next summer.

MS. JUNOD: Next summer? Maybe I'll be

back.

I just want to go back again, we were talking about resources, and you've said that you've had available technology people, in terms of the kind of techniques that you use to do your inspections. What about just in general inspector resources on your team, do you have enough people who are certified and trained to do the work that you need to get done each season? Any issues at all with equipment and people?

MR. PRIBULA: We've always -- we've managed to make do. I only have two people working for me directly for the fracture critical, so we've always had to borrow somebody from either the bridge crew, which is a good learning curve for them --

MS. JUNOD: Okay.

MR. PRIBULA: -- or for -- which is where I hire my inspectors from.

MS. JUNOD: Okay.

MR. PRIBULA: My inspectors are what we call engineer specialists in the metro.

MS. JUNOD: Okay.

MR. PRIBULA: And an engineering specialist is usually an individual who probably has gotten more about engineering than the engineer. My

two guys are pretty competent. They're Kurt Fuhrman and Vance Desens.

MS. JUNOD: Okay.

MR. PRIBULA: And I'm very fortunate to having these guys working with me. I've had another gentleman who is now working in CO, Pete Wilson.

MS. JUNOD: Okay.

MR. PRIBULA: And he's excellent. And so I've been very, very lucky in this job, having that quality of people in the job. We bring them up, we also get -- we'll get, like Pete comes over, we'll get graduate engineers, we'll get -- it depends on the schedule, on who is working, for that fourth person --

MS. JUNOD: Okay.

MR. PRIBULA: -- in the bucket. There again, it's two sets of eyes and safety issues.

MS. JUNOD: Okay. So you have four, two teams of two?

MR. PRIBULA: Yes.

MS. JUNOD: Okay.

MR. PRIBULA: Well, on the scope of the bridge, that's size dependent.

MS. JUNOD: Okay.

MR. PRIBULA: Sometimes if it's like Fort

Snelling bridge, which is over Trunk Highway 5 over the Mississippi River, we'll only have one super out there, that's only two guys.

MS. JUNOD: Okay.

MR. PRIBULA: If it's like 35W, or if it's the High Bridge, it's two supers, it's faster. I can do it in a week, or I can do it in two weeks with one. With two persons, you know.

MS. JUNOD: Okay.

MR. PRIBULA: If you're asking if -- if there's a crystal ball, what would be nice, that fourth individual in the metro, and I think that may be under consideration right now.

MS. JUNOD: On your team, so that would be --

MR. PRIBULA: Designated to me.

MS. JUNOD: So that would be Kurt plus Vance plus somebody else.

MR. PRIBULA: Somebody else.

MS. JUNOD: Okay.

MR. PRIBULA: And that individual, those guys also write the reports during the winter. That's what we're doing now.

MS. JUNOD: What about just, again, an overall assessment about the availability of maintenance resources to act on the findings that your team brings forth? Can you just give a general sense of where you think that is in terms of routinely keeping up with what needs to be happening on the bridges?

MR. PRIBULA: Being cut.

MS. JUNOD: All right. Again, or have been cut?

MR. PRIBULA: We were cut. Not anymore, that changed. We had six crews when I first started, we're down to five, we were going down to four.

MR. NOBLES: What was the impact of that, Mark?

MR. PRIBULA: It's not going down to four anymore.

MR. NOBLES: Well, when it went to five. I mean, what didn't get done as a result?

MR. PRIBULA: I can't comment on that 'cause that's, again, I don't run those crews. It consolidated a lot of stuff. You know, sometimes we had trouble -- we had had trouble getting replacements to the bridge workers who were either retired or they've quit or they've gone on to other jobs, to construction, et cetera. We typically --

and I'm not saying we, I mean, Phil, and I agree with Phil on this, is by hiring off the street, usually all the bridge workers that we have are either -- basically they're construction workers and they have journeyman cards in carpentry, concrete, or iron. It's specialized work, and a basic maintenance individual, if he or she has the skills, great, but for that individual to walk in and start doing the job, they can't, we need them to start right that day. And, you know, it would be like me trying to weld. It's ugly, let's just put it that way, and I get puddles if it's aluminum. Just a great big puddle. We need those skills right then. You need that competence. Because most of the individuals haven't worked on bridges before, and when you work, when I'm talking to them and, you know, they're doing repairs and they want, you know, 'cause I'll look at the area, they'll go, Mark, can you come out and take a look, what do you want actually here, and then you're talking to these individuals in the same language.

MS. JUNOD: Okay.

MR. NOBLES: Do you think there is any relationship between the reoccurrence of inspection issues on the 35W bridge and the cutbacks in the

construction -- in the maintenance crews?

MR. PRIBULA: Not really. The reoccurrence is on -- because the reports that we wrote, the way the bolts keep on popping up, to an individual like yourself, or you, are -- because as one they are notes to us, and we should have called them better than what I did on signing it. I should have said -- made a special heading of things to watch for, or something like that, instead of putting it in as recommendations. Some was deferred. You know, could we have flushed better. You know, that type of stuff. That's honest.

Could we have done some work? Yes. Could our communications have been better between us and inspection? Yes. Did we do the job? Yes. We weren't malfeasance about it, but we didn't have a really good -- hindsight says we didn't have good controls of the communication to get -- make sure that I will tell Phil on what to do and how -- I wouldn't tell him how to do it, but I would say, you know, next year or, you know, can you stuff bolts, can you put these bolts in on the stringer bearings, which is what the Star and Tribune were figuring out that was a big problem, and you guys haven't talked about it. But in our judgment, when you got four

bolts up on the stringer block, anchor block, and one is missing, it's like, okay, we'll get to it. You know. Three out of the four are holding it, it's not going anyplace, you know.

MR. NOBLES: So that is another one of those things that you think the media has focused on too much?

MR. PRIBULA: Yeah. And they focused on corrosion. Corrosion is -- you're always going to have them corroding. I mean, you're always going to be -- we wait until it gets to a certain point to schedule to be painted. It's just like your house. You know, if you started it with one board you'd be -- you can't afford to paint the house every year for that, the entire house.

These bridges take, you know, in some cases they are huge amounts of investment for just -- because we have to do, in some cases we have to do total containment, and that's very costly to do it. Because of what the primer was in the '60s when they built it, which is red lead. And, you know, it's great stuff, but it's not really good for the environment. That's a problem.

The features that we do on the bridges, that's really, really important that we did it.

I've lost my train of thought on where we were going with that.

MR. NOBLES: Okay. Let me ask you, though, maybe you can come back to that, but --

MR. PRIBULA: Just can you rephrase the question and I'll answer it again? I'm sorry.

MR. NOBLES: Well, I think we were talking generally. We'll move on.

MR. PRIBULA: Okay.

MR. NOBLES: Maybe we'll come back to it.

Because I did want to ask how much you have had contact directly with the NTSB?

MR. PRIBULA: The first couple days, very limited.

MR. NOBLES: Okay.

MR. PRIBULA: But our management kept me out of it, and because it was emotional for me.

MR. NOBLES: Okay. Has NTSB requested --

MR. PRIBULA: They have not requested to even talk to me.

MR. NOBLES: I take it, then, you have not made any statement or had a comparable interview with NTSB as we're having with you now?

MR. PRIBULA: No, not at all.

MR. NOBLES: Okay.

MR. PRIBULA: And I'm not volunteering it.

MR. NOBLES: I think Deb and I both want to kind of cover issues about information flow and that sort of thing.

MS. JUNOD: Good.

MR. NOBLES: Do you want to do that, or --

MS. JUNOD: Yeah, go ahead, if you want to.

MR. NOBLES: Well, Mark, you know, one of the reasons we're being asked to do this, and there are other people working on these issues as well, is rightly or wrongly, there is now a kind of cloud of suspicion or concern about MnDOT. And there's even been accusations, I think it's fair to say, by some legislators that people in MnDOT, such as yourself, they're real experts and engineers, are being controlled by MnDOT management, and specifically told that you can't say certain things to people. Is there any truth to that?

MR. PRIBULA: No. If I -- after the collapse, I don't think so, let's put it that way. I'm not told to muzzle my opinions or my comments by management at all. I -- when I'm asked to participate in a question and answer with the reporters from either the Star and Trib or, you name it, that we will go through the public affairs coordinator per our procedures, and I'll answer an e-mail. And our -- it would be in conjunction -- it's a group effort with us, because some of the issues are very complex and, quite frankly, I'm not -- I'm an engineer, I'm not a wordsmith person. I can write, but it's, you know, two-finger typist, and I feel more comfortable with having somebody review it.

And not in the review of censoring it, more into making it so that somebody, of the reporter, whoever, asking the question can understand it without me going off into engineering-ease. And sometimes I do it, sometimes -- I normally think that when I'm talking, even within our group as amongst engineers, and where I'm digressing and I know it, you say -- we use numbers, everybody in the room is going what, what, and you go, oh, 35W, or you actually have to say it's 149. We said names of bridges, Smith Avenue, High Bridge. Well, where is that? It's Trunk Highway 149 by the Xcel Energy plant. That's what it is, that's what you have to actually talk about.

And what I'm saying is I tend to use that shorthand in my comments back. And some of us, we all do this, engineers, and that's why I say I'd prefer to have somebody look at it.

And the other thing is, immediately after the collapse, somehow they got my home number, and they were calling every hour on the weekend when I was out on the bridge. And my wife -- and I finally told my wife, I says, don't even answer, just let the message machine ring. And finally one called on Sunday, it was Sunday, and I called up the public affairs people and I was -- one guy, and I just said -- I was swearing and everything else at them, and said this is not you, I'm swearing at them, it's not you, but if they'd call them up and tell them to stop.

MR. NOBLES: Specifically, for this interview, Mark, were you instructed or given --

MR. PRIBULA: No.

MR. NOBLES: -- guidance in any way by anybody at MnDOT on what you could or could not say?

MR. PRIBULA: No.

MR. NOBLES: Okay.

MR. PRIBULA: Definitely not.

MR. NOBLES: You've served in MnDOT over several administrations. How long exactly have you been here?
MR. PRIBULA: I was hired in 1986.
MR. NOBLES: Um-hum. And administrations bring priorities and there are policies, and has there been any specific impact that you felt from the current administration on the work that you do?
MR. PRIBULA: The cutting of the budgets.
MR. NOBLES: Okay.
MR. PRIBULA: That's the thing that we feel.
MR. NOBLES: And how specifically do you feel it?
MR. PRIBULA: The morale of your employees, your peers. I think that's how you feel it. That's what you feel. But that's -- you felt that with the previous administration also.
You know, let me interject here, and this is again my opinion, you know, every -- you can't hold the administration, you also got to hold the legislature accountable too. It goes both ways.
MR. NOBLES: I actually wanted to ask you a question or two about the legislature. As you know, in addition to the Office of the Legislative

Auditor there's been a special committee created with House and Senate members on it to investigate the bridge collapse. Have you participated in any way in any of those hearings?
MR. PRIBULA: Not yet.
MR. NOBLES: Have you listened to them?
MR. PRIBULA: No.
MR. NOBLES: Okay. Have you had any contact with articles or media in which legislators have voiced opinions about MnDOT or the bridge collapse?
MR. PRIBULA: Yes.
MR. NOBLES: What's your opinion about what you've read or heard or seen?
MR. PRIBULA: They don't know what they're talking about. They're not engineers.
MR. NOBLES: Okay.
MR. PRIBULA: I think they have their -- I think they have the best intentions, but they're also politicians at the same time. You know, it's hard to read what they actually are thinking just by a reading of -- just by reading a paragraph in the paper. And now I'm questioning what was actually said in the paper because they can't get it right about the bridge, you know.

MR. NOBLES: Have those legislative hearings had an impact on morale?
MR. PRIBULA: Yes.
MR. NOBLES: In what way?
MR. PRIBULA: Negative.
MR. NOBLES: Why?
MR. PRIBULA: We jokingly say, and I've told my wife this, as of the case of the latest go around with what you were involved with, with the aim that they can't shoot straight.
MR. NOBLES: You mean (inaudible)?
MR. PRIBULA: Yes.
MR. NOBLES: Too much bad news about MnDOT.
MR. PRIBULA: Yeah.
MR. NOBLES: In general.
MR. PRIBULA: And, you know, it's just -- you know, what happened, how did it get broke so bad and how do we fix it. You know, and my wife says, what's going on over there, is this -- I don't know, Susie, you know, but it's just what we've got, what's happened to us, you know, where's their sense of direction. When it rains, it pours.
MR. NOBLES: Yes.
MR. PRIBULA: It's very, very, you know,

all of us, I mean, bridge workers, I'm involved with the constant -- the drumming from both the legislature and the administrations, that were, you know, it's like, okay, we're great for plowing snow, but then after that, you know, I don't know, we forget about you.
You know, everybody wants to pass the new bills for building roads, nobody wants to be the guy or woman who passes the bonding bill to take care of the roads, you know. And that's what we're not seeing, we're not seeing that. That may change. Maybe people finally understand that. You know. And are we selling it, are we selling ourselves wrong at the legislature, or I don't know, I'm just a senior engineer. You know, I try and do my job and I try to do it professionally.
MR. NOBLES: What else?
MS. JUNOD: Let me think.
Okay. Let's see. We ran through how the inspection findings are reviewed, anything that you want to -- or how they're used, I guess. Anything else you want to add in terms of what happens when you're finished with your work that you think we should know about that process?
MR. PRIBULA: We typically -- it's not

instantaneous report. As you see, these reports are 70, you know, 60, 70 pages long. We finish, we are booked usually solid for inspection, and various types of inspections. We do the snoopers, then we'll go to something else, which doesn't require a snooper, which means we're crawling through something else. Or routine inspections, which are the normal highway interchanges.

MS. JUNOD: Right.

MR. PRIBULA: Where this is all leading to is that the report is written usually three to four months later.

MS. JUNOD: Okay.

MR. PRIBULA: And we keep the documentation that are actual hard copies. We use paper, we drop paper in the water, it kind of floats, instead of a computer. So --

MS. JUNOD: Your field notes?

MR. PRIBULA: Yes.

MS. JUNOD: They are field notes, right?

MR. PRIBULA: Right. We keep the handwritten field notes, but we discard the handwritten field notes once that copy you have is written. We just don't have the room.

MS. JUNOD: Pardon?

MR. PRIBULA: We don't have the room to keep them.

MS. JUNOD: Okay.

MR. PRIBULA: The written documentation. We've always just done it that way, we don't keep them, we just toss them. We have too many bridges. And that's what we'll do. That's our normal procedures. And plus we're doing the Pontis reports that have to be in. This information all usually has to be done by February.

MS. JUNOD: Right.

MR. PRIBULA: So we're under those kind of deadlines.

MS. JUNOD: Okay. If you have any additional thoughts on the follow-through from inspections, anything that I didn't ask about, in terms of your work with Phil or as things move through the chain for actual maintenance work that gets done afterward, anything else you want to add on that?

MR. PRIBULA: Yeah. Like I said, just expand, you know, if they're doing -- when they're doing repair work, the bridge crews know that one of the inspectors usually has said that this is a problem, they will usually call and say can you come

out or, you know, can Phil or, you know, or Vance come out, or can Kurt come out. Mark, you were here, usually, because I'm the engineer they would say can you come out and take a look at it, your guys found this and what do you want us actually to do.

MS. JUNOD: Okay.

MR. PRIBULA: And, you know, Phil doesn't have an issue with that. We work hand in hand, even though I don't have -- the way we are organized, I don't have direct supervision over him, and he doesn't have it over my guys, but when we're out in the field neither one of us has a problem with saying can you do this, do that.

MS. JUNOD: Okay.

MR. PRIBULA: I mean, we're not that worried about the structure that way, chain of command, I guess is what it is called.

MS. JUNOD: Okay. In thinking about your whole role in the fracture critical bridges, in your opinion have the need to get done stuff is getting done on those bridges? I'm trying to distinguish the need to get done from maybe some basic or routine maintenance things where you're not as concerned if that gets deferred. Just your sense

there on where that balance is falling.

MR. PRIBULA: It could be better.

MS. JUNOD: Okay.

MR. PRIBULA: I'll be honest. It could be better. I think we're -- with these documentation procedures that we're putting in it will get a lot better.

MS. JUNOD: Okay.

MR. PRIBULA: The communication will help, and then we can document it that we actually had it done by the crew. And, you know, that way we have a work order tracking system for it.

MS. JUNOD: Okay.

MR. PRIBULA: And we don't have that, like you said, in District 3, we don't have that, we don't have, you know, they probably may have a third of the size of our bridges.

MS. JUNOD: Probably, yeah.

MR. PRIBULA: And, you know, the other thing is, like in the other states, in the out-state districts, they can get out in the bridges much longer, and they can -- their bridge crews might work 10-hour days, so they can be out there, you know, four days a week.

MR. NOBLES: Because of traffic?

MR. PRIBULA: Traffic, yeah.

MS. JUNOD: So you have a degree of difficulty just addressing issues here.

MR. PRIBULA: They've got less logistic issues.

MS. JUNOD: Okay. And just one last time, do you have any concerns about your ability to raise an issue about a bridge and be listened to?

MR. PRIBULA: Nope. I went on another bridge, that I will not talk about, a former state bridge engineer said change this rating for funding so we get funding replacement. I said no. And I said why, I told my boss and I told his -- that was Jack at the time, and the reason I said why was that if I lower that rating, that's a domino effect, it will change three other ratings on the bridges. And then the FHWA may or may not see it and say why did you change that, that rating. Because now there's a rating for what we call a superstructure rating, the MVI rating on your Pontis, when you lower it down and you get -- if they were able to lower it, they could get funding. And they wanted us to do it at the district level and I said no, it's not that bad yet. And then I said the reason is 'cause if I change that one, then three other bridges, which are fracture critical, will also have to be lowered.

And I wrote a letter, I think I wrote a letter and said no, I said this is why, and I told Jack Pirkl and I told Sue Mulvihill, which was his boss at that time, I believe, and what was going on.

MR. NOBLES: Are you aware of any other situation that you were not directly involved with where people were asked to change a rating and had an issue with that?

MR. PRIBULA: I am not aware of any of those issues.

MS. JUNOD: Okay.

MR. NOBLES: Is there something in the system, aside from personal integrity, that would catch something like that that might occur?

MR. PRIBULA: Yes. The big flag, 'cause if you read your Pontis reports and you'll look at the engineer reviews of the Pontis reports, and you'll go why are you dropping this from a six to a seven or a six to a five, and you look at the bridge and you go, you know, it's like then you'd walk back and you'd say why are we doing this.

MR. NOBLES: Okay.

MR. PRIBULA: But the other thing is is that the state engineer, his authority can do that. He can overrule you and just say this is what we're going to do. And you say okay.

MR. NOBLES: But there's documentation of that?

MR. PRIBULA: There is documentation of that. In this particular instance they were able to say documentation of why they changed the rating, but I had bridge, our central office bridge do it. They then wrote the documentation. It was a funding mechanism to replace a bridge. That's what it was for. It wasn't structural. It was not structural at all, it was a funding mechanism. And to try and get the money to replace the bridge and that's why they had to do it.

MS. JUNOD: It was an out-of-the-ordinary incident --

MR. PRIBULA: Yes.

MS. JUNOD: -- in your experience?

MR. PRIBULA: Yes.

MS. JUNOD: Okay.

MR. NOBLES: The ultimate out-of-the-ordinary case has been raised in reference to the whole situation of the 35W bridge collapse, and that's what happened with the High Bridge back some years ago. Were you involved in --

MR. PRIBULA: No, I was just a grad engineer at that time. I wasn't -- I was working in Mankato at the time, so I was not involved with that.

MR. NOBLES: Have you ever done any retrospective analysis of the closing of the High Bridge?

MR. PRIBULA: Yeah.

MR. NOBLES: And do you think it was -- the action of closing it was justified on the engineering evidence that you've seen?

MR. PRIBULA: Yes. Conservative. Better to err. The original bridge is what we call a pin and eye bolt, which means it's just pins, there's a 10-inch shaft or a 12-inch shaft about, you know, this could be 24 inches long or, you know, however long they are, about six to eight to 12 inches in diameter. And then you take the members, and that's what basically holds the bridge together. Well, if they -- the members are on that pin, you know, they'll rotate on each channel, and the equipment that they had at the time couldn't tell if they were cracking and where. And the other problem is that in 1968 it was the same construction on a West Virginia bridge that went down, the Silver Creek one. When it cracks, everything goes. One goes, it all comes down. There's no way other than that.

MR. NOBLES: The history, the popularized history of that situation credits Richard Braun, who was then commissioner and was an engineer. You say you've done some retrospective analysis. Do you think that the High Bridge would have been closed by the system, whoever was commissioner? Or did it take an engineer as commissioner to know that that's the action that was necessary?

MR. PRIBULA: I think it would take a commissioner who has good people working for him or her. If you have the right engineers. The commissioner doesn't have to be an engineer. It's nice, but it doesn't have to be an engineer. Because an engineer -- if he or she has good people below him, reporting to him saying this is why we need to close it, this is it, then the commissioner should be able to say I'm closing this bridge for this reason.

And then, you know, instead of Braun could say I'm an engineer, this is why we're doing it, for these reasons, I understand this. The nonengineer commissioner would probably have to say my people -- or my people, I mean, my staff is

recommending, my engineering staff is recommending it for these reasons, I concur with it. That would be the only difference I would see that would do it that it was the right call. I just (inaudible).

MR. NOBLES: Mark, is there anything else you want to add to the record?

MR. PRIBULA: Not at this time.

MR. NOBLES: Okay.

MS. JUNOD: Nothing else that you thought we would ask about or that you think? We're trying to tell a story to the legislature about how bridge inspection works.

MR. NOBLES: And we wanted to do it in the most accurate, objective way possible.

MS. JUNOD: Accurate, objective, with a looking forward to what kinds of recommendations could we make that would help make your job easier.

MR. PRIBULA: I think, to summarize it, I think, you know, some of our changes that we've done, that we've proposed to do, some of the changes that the feds will be changing will change our thing, our methods.

MS. JUNOD: Okay.

MR. PRIBULA: The other thing is maybe investigate better funding for some of the newer

technology.

MS. JUNOD: Okay.

MR. PRIBULA: Like, if you're going to replace a bridge, it's going to have a system for monitoring the fatigue cracking, I believe, you know, that type of stuff. Maybe we should retrofit some of the bridges with that.

MS. JUNOD: Okay.

MR. PRIBULA: So, you know, they would fund us better for some of our de-icing equipment that we have on the bridges. You know, and trying to find the money just to get that done. And they work. That's been proven. I think those are the things.

I've read a lot of training and stuff about reports and inspectors, maybe we should have some better training, 'cause we have problems out there nationwide. And the feds are aware of that. You guys may have seen the reports. There's a FHWA report about the inspection, inspectors, that's a concern of mine, as I read it. And I read it for grad school before that. You know, how do we fix that, I don't know.

MS. JUNOD: Okay.

MR. PRIBULA: You know, those issues.

And within our own house, better communication, better tracking for us.

MS. JUNOD: Okay.

MR. NOBLES: And should we accelerate the replacement of these bridges that have questionable design?

MR. PRIBULA: We are already moving to trying to accelerate bridges. We're moving ahead with -- metro, and you're going to have to probably ask my managers, I've been involved a little bit on it. They, you know, how would you -- how would you rank replacement bridges, can you move forward some of these bridges. Specifically, Hastings, Cayuga, Stillwater, Lafayette. You know, those are the ones. Then that's just those four, and there's a whole bunch of others out there.

You know, it's a funding -- as the legislature -- the legislature and the administration, it's a funding mechanism. You know. You guys read the paper and you're probably more aware of the money issue than us, but we know it's money. And I don't know where the money is going to come from.

MR. NOBLES: Are we ready to end?

MS. JUNOD: I'm ready to end.

MR. NOBLES: Okay. We're going to turn the tape machine off and it is 10:37.

(Interview concluded.)

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

REPORTER'S CERTIFICATE

I, Janet Shaddix Elling, do hereby certify that the above and foregoing transcript of the tape-recorded proceeding, consisting of the preceding 89 pages is a full, true and complete transcript of the tape-recorded proceedings to the best of my ability.

Dated January 14, 2008.

JANET SHADDIX ELLING
Registered Professional Reporter

From: Gary Peterson **Sent:** Mon, 12 Jan 2004 08:41:23 GMT

To: Bruce Iwen; Paul Kivisto; Paul Rowekamp;

CC:

Subject: Paint sort final

paint final.xls (438272Kb) **Paintsort.doc** (25088Kb)

1. Sort by Age – Bridges1955 and older candidates for replacement
    - a. Sort 1955 and older by condition (shade group temporarily)
        1. Bridge with Deck condition 7 or 8 not identified for replacement due to deck condition. Assign a temporary color code of 1 for these bridges
        2. Bridges with deck condition 6 or less should have been replaced under deck condition analysis. Assign a color code of 0 no color.
        3. Sort by color code 1, then condition.
            - a. Bridges with Superstructure condition 5 or less should be replaced
            - b. Sort Condition Code 5 or less by paint age
                - Painted 1995 and later Rose – Replace 2024-2030
                - Painted 1986 –1994 Pink – Replace 2015-2023
                - Painted before 1986 Red – Replace 2003-2014
        4. Sort bridges with condition deck condition Codes 7 or 8 by paint age.
            - Painted 1995 and later Light Green – Paint 2024-2030
            - Painted 1986 –1994 Bright Green – Paint 2015-2023
            - Painted Before 1985 Lime Green – Paint 2003-2014
2. Sort Bridges older than 1955 by % unsound paint, then age of paint system. All bridge built after 1955 with Deck Condition Code > 6 and Super > 5 will require painting prior to 2030.
    - a. For bridges that do not have a % unsound paint recorded or 0%
        1. Determine total square foot per year requires painting. For the period 7 yrs at .450/year = 3.2 Msf = about 1995 and newer bridges.
            - Painted 1995 and later Blue Grey – Paint 2024-2030
            - Painted 1986 –1994 Blue – Paint 2015-2023
            - Painted Before 1985 Pale Blue – Paint 2003-2014
    - b. For bridges that do have a % unsound paint recorded
        1. Determine the total square foot per year that requires painting. For the 7 year 2024-30 period requires about 4M sf or .567M per year. Choose % cutoffs that come closest to the average yearly total
            - Unsound paint <5% Light Yellow – Paint 2024-2030
            - Unsound Paint 5-9% Yellow – Paint 2015-2023
            - Unsound Paint > 9% Gold – Paint 2003-2014

RJM

MAXIM
TECHNOLOGIES INC

Maxim Technologies, Inc.\ Twin City Testing Inc.
662 Cromwell Avenue
St. Paul, MN 55114-1776
Telephone: (612) 659-7317
Fax: (612) 659-7348

December 4, 1997

Mr. Gary Peterson
MN DOT Office of Bridges and Structures
Waters Edge Building
1500 W County Road B2
Roseville, MN 55113
Fax: 612-582-1110

Subject: **Strain Gauge Installation/Monitoring of Bridge 9340 - TH 35W over Mississippi**

Dear Gary:

In response to your request for a quote to perform the above as described in your Facsimile Memo of December 1, 1997, I present the following:

Preliminary preparation (Senior Staff Engineer, $91)	12 h	$1092
Installation of strain gauges (Senior staff eng, $101)*	16 h	$1616
Monitoring / Recording of Data (Principal engineer, $103)	8 h	$ 824
Monitoring / Recording of Data (Senior staff eng, $101)*	8 h	$ 804
Data Reduction / Report (Principal Engineer, $103)	10 h	$1030
Equipment charge / Setup		$ 800
Materials and consumables		$ 800
Estimated Total:		$6966

* Hourly Rate includes $10/h 'hazardous duty' rate.

Please call me at 659-7317 if need additional information. I will be available this week to further discuss specific number of strain gauges and recording channels required. I have allowed for equipment rental for additional channels.

Sincerely,
Randy Hochstein
Randy Hochstein
Vibration\Acoustics Engineer

Reviewed by:
Richard O Thomalla
Richard O. Thomalla
Mechanical Testing Supervisor

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Minnesota Department of Transportation
Office Of Bridges and Structures

FACSIMILE TRANSMITTAL

TO : **Randy Hochstein**
Project Manager

COMPANY : **Maxim Technologies**

TELECOPIER : **612 659 7348**

FROM : Bob Miller
Bridge Agreements Engineer
Office Of Bridges and Structures
Minnesota Department of Transportation
Waters Edge Building
Roseville, Minnesota 55113

Return Phone : (612) 582-1104
FAX : (612) 582-1110

Date : **Dec 17, 1997**
Time :
No. Pages : 1

Subject: Bridge 9340 - TH 35W over Mississippi
Installation of Strain Gauges to measure stress in floorbeam connection

Instructions: Yesterday you informed us that you have not received a notice to start work on the subject project. The general scope of the work is described in the information transmitted to you December 1, 1997 and as quoted by Maxim in their letter dated December 4, 1997. Because, cracking in the area of the floorbeam stringer connection may threaten public safety, you are authorized to begin work immediately. Contract documents are in the process of being prepared.

Minnesota Department of Transportation

Office of Technical Support
Consultant Services Unit
Mail Stop 680, Seventh Floor
395 John Ireland Blvd.

Phone: (612) 296-9741
Fax: (612) 282-5127

January 14, 1998

Mr. Randy Hochstein
Maxim Technologies Inc.
662 Cromwell Avenue
St. Paul, MN 55114-1776

In Reply, please refer to:
Mn/DOT Agreement 77059
Bridge monitoring

Dear Mr. Hochstein:

Enclosed are five copies of the above mentioned agreement to monitor the cracks in bridge 9340 on I-35W over the Mississippi River.

If this meets with your approval, please have all copies signed and return to me at the above address.

You will receive a copy of this agreement when it is fully signed.

If you have any questions, please call me.

Sincerely,

Linda Moline

Linda Moline
Associate Agreement Administrator

cc: Bob Miller
File

Mn/DOT Agreement No. 77059

STATE OF MINNESOTA
CONTRACTUAL (nonstate employee) SERVICES

Accounting Information:

Agency: T-79	Fiscal Year: 1998	Vendor Number: 200025162 00
Total Amount of Contract: $6,966.00	Amount of Contract First FY: $6,966.00	
Commodity Code: 030 06	Commodity Code:	Commodity Code:
Object Code: 2D10	Object Code:	Object Code:
Amount: $6,966.00	Amount:	Amount:

Accounting Distribution 1:	Accounting Distribution 2:	Accounting Distribution 3:
Fund: 270	Fund:	Fund:
Appr: 209	Appr:	Appr:
Org/Sub: 6631	Org/Sub:	Org/Sub:
Rept Catg:	Rept Catg:	Rept Catg:
Amount: $6,966.00	Amount:	Amount:

Processing Information:

Contract: 418207 / 12-12-97 / LDM
Number/Date/Entry Initials

Order: 31203939 / 12-12-97 / LDM
Number/Date/Signature
[Individual signing certifies that funds have been encumbered as required by Minn. Stat. § 16A.15.]

Budget Office: Timothy Johnke 3/27/98
(Authorized Signature)

THIS CONTRACT, which shall be interpreted pursuant to the laws of the State of Minnesota, is by and between the State of Minnesota, acting through its Commissioner of Transportation (hereinafter "Mn/DOT") and Maxim Technologies, Inc., address 662 Cromwell Avenue, St. Paul, MN 55114-1776 (hereinafter "CONTRACTOR").

WHEREAS, Mn/DOT, pursuant to Minnesota Statutes Section 16B.17 and 15.061, as enacted, is empowered to enter into professional and technical service contracts in connection with the operation of the agency; and

WHEREAS, Mn/DOT has determined the need to monitor cracking of structural steel bridge members on an emergency basis; and

WHEREAS, CONTRACTOR represents that it is duly qualified and willing to perform the services set forth herein.

MN / DOT
CP

NOW, THEREFORE, it is agreed:

I. **CONTRACTOR's DUTIES** CONTRACTOR, who is not a state employee, shall:
(Any additional attachments are incorporated herein and made a part of this contract.)

Attach strain gauges and monitor cracks in structural steel of bridge number 9340, on Trunk Highway I-35W over the Mississippi River, as directed by the Mn/DOT Project Manager.

Cracks are located at floor beam to girder three connected at north end of truss.

Contractor shall install four gages at floor beam and four strain gauges at girder three. Contractor shall monitor strains under loads induced by Mn/DOT trucks and provide a report on their findings.

II. **CONSIDERATION AND TERMS OF PAYMENT**

A. Consideration for all services performed and goods or materials supplied by CONTRACTOR pursuant to this contract shall be paid by Mn/DOT as follows:

1. Compensation: shall be on a lump sum basis.

2. Reimbursement for travel and subsistence expenses actually and necessarily incurred by CONTRACTOR in performance of this Agreement shall not exceed zero dollars ($ 0); provided, that CONTRACTOR shall be reimbursed for travel and subsistence expenses in the same manner and in no greater amount than provided in the current "Commissioners Plan" promulgated by the Commissioner of Employee Relations. CONTRACTOR shall not be reimbursed for travel and subsistence expenses incurred outside the state of Minnesota unless it has received prior written approval for such out of state travel from Mn/DOT.

The total obligation of Mn/DOT for all compensation and reimbursements to CONTRACTOR under this contract shall not exceed six thousand nine hundred sixty six dollars ($ 6,966.00).

B. Terms of Payment

1. Payment shall be made by Mn/DOT promptly after CONTRACTOR's presentation of invoices for services performed and acceptance of such services by Mn/DOT's Authorized Representative pursuant to Clause VI. Invoices shall be submitted in a form prescribed by Mn/DOT and according to the following.

   Invoices shall identify the cost for the services performed and/or goods delivered for the billing period and shall satisfy the requirements listed below. Invoices shall be submitted, using the enclosed cover sheet, no more than once each month. Invoices shall be numbered sequentially.

   Each invoice must contain the following information: Mn/DOT agreement number, Mn/DOT agreement invoice number (sequential), billing address if different from business address, and CONTRACTOR's original signature attesting that the invoiced services and costs are new and that no previous charge for those services and/or goods has been included in any prior invoice.

   Each invoice shall have support documentation attached. Direct nonsalary costs allocable to the project, and approved by the Agreement Administrator, prior to incurring costs, shall be itemized and supported with invoices or billing documents to show that such costs are properly allocable to the project. Support documentation shall be separated in an orderly manner and correspond with each direct cost.

2. In accordance with Minnesota Statutes Section 16B.17, subdivision 5 (b), as enacted, no more than ninety percent (90%) of the compensation due under this contract may be paid until the final product(s) of this contract have been reviewed by Mn/DOT and it has determined that the CONTRACTOR satisfactorily fulfilled all the terms of this contract.

3. (When applicable) Payments are to be made from federal funds obtained by Mn/DOT through Title N/A of the N/A Act of N/A (Public law N/A and amendments thereto). If at any time such funds become unavailable, this contract shall be terminated immediately upon written notice of such fact by Mn/DOT to CONTRACTOR. In the event of such termination, CONTRACTOR shall be entitled to payment, determined on a pro rata basis, for services satisfactorily performed prior to termination.

III. CONDITIONS OF PAYMENT All services provided by CONTRACTOR pursuant to this contract shall be performed to the satisfaction of Mn/DOT, as determined in the sole discretion of its Authorized Representative, and in accord with all applicable federal, state, and local laws, ordinances, rules and regulations. CONTRACTOR shall not receive payment for work found by Mn/DOT to be unsatisfactory, or performed in violation of federal, state, or local law, ordinance, rule or regulation.

IV. TERM OF CONTRACT This contract shall be effective upon date of execution and approval, or upon the date that the final required signature is obtained by Mn/DOT, pursuant to Minnesota Statutes Section 16B.06, subdivision 2, as enacted, which ever occurs later, and shall remain in effect until March 31, 19 98, or until all obligations set forth in this contract have been satisfactorily fulfilled, whichever occurs first.

CONTRACTOR shall not begin work under this contract until ALL required signatures have been obtained and CONTRACTOR has been notified to begin such work by Mn/DOT's Authorized Representative.

V. CANCELLATION This contract may be canceled by Mn/DOT at any time, with or without cause, upon thirty (30) days' written notice to the other party. In the event of such a cancellation CONTRACTOR shall be entitled to payment, determined on a pro rata basis, for work or services satisfactorily performed.

VI. AUTHORIZED REPRESENTATIVES Mn/DOT's Authorized Representative for the purposes of administration of this contract is :Linda D. Moline, Associate Agreement Administrator, 395 John Ireland Blvd., Mail Stop 680, St. Paul, MN 55155, phone (612) 296-9741. Such Representative shall have final authority for acceptance of CONTRACTOR's services provided under this contract. If such services are accepted as satisfactory, Mn/DOT's Authorized Representative shall certify the service's acceptance on each invoice submitted for payment.

The Mn/DOT Project Manager for this agreement is Robert J. Miller, phone (612) 582-1104.

CONTRACTOR's Authorized Representative for the purposes of administration of this contract is Randy Hochstein, Vibration \ Acoustics Engineer telephone number (612) 659-7317.

VII. ASSIGNMENT CONTRACTOR shall neither assign nor transfer any rights or obligations under this contract without the prior written consent of Mn/DOT.

VIII. AMENDMENTS Any amendments to this contract shall be in writing, and shall be executed by the same parties who executed the original contract, or their successors in office.

IX. LIABILITY CONTRACTOR shall indemnify, save, and hold Mn/DOT, its agents, and employees harmless from any and all claims or causes of action arising from the performance of this contract by CONTRACTOR or CONTRACTOR's agents or employees. This clause shall not be construed to bar any legal remedies CONTRACTOR may have for Mn/DOT's failure to fulfill its obligations pursuant to this contract.

X. STATE AUDITS The books, records, documents, and accounting procedures and practices of CONTRACTOR relevant to this contract shall be subject to examination by the Mn/DOT auditor, and the state or legislative auditor, as appropriate.

XI. DATA PRACTICES, OWNERSHIP OF COPYRIGHT, AND OWNERSHIP OF MATERIALS

A. CONTRACTOR shall comply with the Minnesota Data Practices Act, Minnesota Statutes Chapter 13, as enacted, as it applies to all data provided by Mn/DOT in accordance with this contract and as it applies to all data created, gathered, generated, or acquired in accordance with this contract.

B. All right, title, and interest in all copyrightable material which CONTRACTOR shall conceive or originate, either individually or jointly with others, and which arises out of the performance of this contract shall be assigned to Mn/DOT along with ownership of any and all copyrights in the copyrightable material. Upon request of Mn/DOT, CONTRACTOR shall execute all papers and perform all other acts necessary to assist Mn/DOT to obtain and register intellectual property rights in such materials. All works of authorship created by CONTRACTOR for Mn/DOT pursuant to this contract shall be considered "works made for hire" as defined in the U.S. Copyright Act.

C. Any reports, studies, photographs, negatives, or other documents prepared by CONTRACTOR in the performance of its obligations under this contract shall be the exclusive property of Mn/DOT and all such materials shall be remitted to Mn/DOT by CONTRACTOR upon completion, termination or cancellation of this contract.

XII. **AFFIRMATIVE ACTION** (When Applicable) CONTRACTOR certifies that it has received a certificate of compliance from the Commissioner of Human Rights pursuant to Minnesota Statutes Section 363.073, as enacted. Minnesota Statutes Section 363.073, as enacted, are incorporated herein by reference.

XIII. **WORKERS' COMPENSATION** In accordance with Minnesota Statutes Section 176.182, as enacted, CONTRACTOR shall provide acceptable evidence of compliance with the workers' compensation insurance coverage requirement of Minnesota Statutes Section 176.181, subdivision 2, as enacted, prior to commencement of any duties to be performed under this contract.

XIV. **PUBLICITY** Any publicity given to the program, publications, or services provided resulting from this Contract, including, but not limited to, notices, informational pamphlets, press releases, research, reports, signs, and similar public notices prepared by or for CONTRACTOR or its employees individually or jointly with others, or any subcontractors shall identify Mn/DOT as the sponsoring agency and shall not be released, unless such release is a specific part of an approved work plan included in this Contract prior to its approval by Mn/DOT's Authorized Representative.

XV. **ANTITRUST** CONTRACTOR hereby assigns to the state of Minnesota any and all claims for overcharges as to goods and/or services provided in connection with this contract resulting from antitrust violations which arise under the antitrust laws of the United States and the antitrust laws of the state of Minnesota.

XVI. **JURISDICTION AND VENUE** This Contract shall be governed by the laws of the state of Minnesota. Venue for all legal proceedings arising out of this contract, or breach thereof, shall be in the state or federal court with competent jurisdiction in Ramsey County, Minnesota.

XVII. **OTHER PROVISIONS** It shall be the Contractor's responsibility to notify the Agreement Administrator and Project Manager, in writing, if the project will not be completed as scheduled. The Project Manager shall have the authority to adjust the schedule, in writing, within the terms of the Contract. It is the Contractor's responsibility to request an amendment in the event the project scope, time schedule, deliverables, costs, or any other aspects differ from the Contract.

IN WITNESS WHEREOF, the parties have caused this contract to be duly executed intending to be bound thereby.

CONTRACTOR

(CONTRACTOR certifies that the appropriate person(s) have executed this contract as required by applicable by-laws or resolutions)

By:

Title: Sr. Vice President

Date: 2-17-98

By:

Title:

Date:

NOTARIZED ACKNOWLEDGMENT
OF CONTRACTOR'S SIGNATURE MUST
ACCOMPANY THIS CONTRACT

Distribution List
Mn/DOT - original (fully executed) contract
Contractor
Department of Administration
Mn/DOT Authorized Representative

DEPARTMENT OF TRANSPORTATION

By: D. S.

Title: DIVISION DIRECTOR

Date: 3/10/98

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

By: Lynn A. Klessig 3/13/98
~~Assistant Attorney General~~ Legal assistant

DEPARTMENT OF ADMINISTRATION

By:

Date: 3/27/98

SELECT ONE

STATE OF Minnesota)
) ss.
COUNTY OF Dakota)

CORPORATE ACKNOWLEDGMENT

On this 17th day of February, 1998, Randall Gatreat (Name) and — (Name), personally known to me, did swear that they are respectively the Sr. Vice President (Title) and — (Title) of Marin Tech. (Name) a corporation under the laws of the state of Delaware (Name), and did execute this instrument on behalf of the corporation by authority of its Board of Directors on behalf of the corporation.

PARTNERSHIP ACKNOWLEDGMENT

On this _____ day of _____________, 199____, _______________________________ (Name), personally known to me, did swear that he/she is a partner in ______________________ (Name), a partnership under the laws of the state of _____________ (Name), and did execute this instrument on behalf of the partnership.

INDIVIDUAL / SOLE-PROPRIETORSHIP ACKNOWLEDGMENT

On this _____ day of _____________, 199___, _______________________________ (Name), personally known to me, did swear that he/she did execute this instrument of his/her own free will intending to be bound thereby.

CHERYL L. JACOBSON
NOTARY PUBLIC-MINNESOTA
My Commission Expires Jan 31, 2000

Cheryl Jacobson
NOTARY PUBLIC

My Commission Expires: 1-31-00

Minnesota Department of Transportation

Memo

Office of Bridges and Structures
Mail Stop 610
Waters Edge
1500 W. Co. Rd. B2

Office Tel: 582-1100
Fax: 582-1110

Date: October 23, 1998

To: Gary Workman
Metro Division Office of Operations

From: for Donald J. Flemming Gary Peterson
State Bridge Engineer

Subject: BR 9340 - Cracks in Approach Span Girders, North End of Bridge Near Pier 9

Bridge number 9340 carries TH 35W over the Mississippi River in Minneapolis. The bridge consists of a steel deck truss main span and continuous steel girder approach spans and was constructed in 1967. During the 1998 bridge safety inspection of the north approach spans in October, 1998, Metro bridge inspectors noticed 12 crack locations in the 48". deep approach span girders at the top of the stiffener/diaphragm connection near Pier #9 at the north end of the bridge. One major crack has already been repaired by the Metro Bridge Maintenance Crew. 11 other cracks are at the web toe of the web to top flange weld in the base metal. These locations are in a negative moment region and thus are in tension. See the attached plan sheet for a detailed location of the cracks.

After review in this office, it is recommended that Metro Bridge Maintenance drill out the ends of the cracks with a 1 1/2" or 2" core drill. The core samples should be submitted to Todd Niemann for analysis of the steel. During drilling it is recommended that ultrasonic testing be completed such that we can be certain the end of the crack has been arrested. If the ends of the cracks can not be drilled out, we will recommend additional procedures or repairs to undertake. Additional recommendations to loosen or modify the diaphragm connections at these problem areas will be discussed at a November 5 meeting.

Since 33 cracks have been found this year in the approach span girders, we are concerned that these locations have potential for further cracking. We recommend that you perform close in-depth inspections of these areas on a six month interval, and keep a detailed weld/crack inspection log for these areas. As suggested by Mark Pribula in an October 14, 1998 memo to Jack Pirkl, it will be prudent to perform a detailed inspection of Br. #27855, I-94 over TH 55, to determine if similar problems exist on another continuous steel structure with high traffic volumes.

I feel that we need to discuss the short and long range plan for Br. #9340. Our office has scheduled a meeting with Metro Division personnel on November 5 from 9:00 to 11:00 in Conference Room D to discuss topics such as the upcoming contract to paint the girders in 1999, redecking the bridge within 10 years, other long term improvements, and any additional repair strategies. Please contact me if you have any comments or concerns with the long range plan for this bridge.

cc:
D. J. Flemming
G. D. Peterson
R. Noreen
E. Evans
J. Pirkl
R. Schultz
J. R. Allen
P. Kivisto
T. Moravec
T. Niemann
M. Pribula
D. Hoff

File Br 9340

Minnesota Department of Transportation

Memo

Bridge Inspection, Maintenance Operations
Metro Division
1500 W. County Road B2
Roseville, MN 55113

Office Tel: 582-1418
Fax: 582-1008

Date: October 14, 1998

To: Jack Pirkl
Maintenance Operations Engineer

From: Mark Pribula
Bridge Inspection Engineer

Subject: Cracked Welds in Approach Spans & Diaphragms at Pier # 9
Br. # 9340 I-35W over Mississippi River

During the 1998 annual inspection of Bridge # 9340, bridge inspectors noticed cracks on the south multi-girder approach spans at the top of the stiffener / diaphragm connection near piers' # 2, # 3, # 4, and # 5. The cracks are in the negative moment region of the spans.

Metro Bridge Inspection felt that because cracks were found on the south multi-girder approach spans near piers' # 2, # 3, # 4, and # 5. We should inspect Pier # 9 on the north multi-girder approach span. During this inspection, bridge inspectors noticed eight cracks at the top flange / web weld, seven cracks at the top of stiffener weld, and two cracks at the web toe of stiffener welds.

The cracked welds in approach spans & diaphragms at Pier 9, locations are as follows:

Crack Type	Girder #	Pier # 9		Span
		N. Side	S. Side	
Beam Web @ Top of Stiffener Weld, Crack Diagonal Downwards, 12" (S) 42"(N)	G-2		X	9
Top Flange / Web Weld	G-4 (Westside)		X	9
Top Flange / Web Weld, (Sm. Horz.)	G-8 (Eastside)		X	9
Top of Stiffener Weld	G-9 (Eastside)		X	9
Top of Stiffener Weld	G-11 (Eastside)		X	9
Top of Stiffener Weld	G-12 (Eastside)		X	9

Crack Type	Girder #	Pier # 9		Span
		N. Side	S. Side	
Top Flange / Web Weld, (4"Lg Turning Down)	G-4 (Both sides)	X		10
Top Flange / Web Weld (W & E) & Top of Stiffener Weld (East)	G-5 (See Note)	X		10
Web Toe of Stiffener Weld, (West) Top Flange / Web Weld (East) & Top of Stiffener Weld (East)	G-9 (See Note)	X		10
Web Toe of Stiffener Weld, (West) Top Flange / Web Weld (East)	G-10 (See Note)	X		10
Top Flange / Web Weld, (W & E) & Top of Stiffener Weld (East)	G-11 (See Note)	X		10
Top Flange / Web Weld, (West & E) & Top of Stiffener Weld (East)	G-12 (See Note)	X		10

Metro Bridge Inspection is requesting that, The Office of Bridges and Structures consider a review of bridges with this similar type of girder / stiffener / diaphragm connection. One possible review candidate is Br # 27855, I-94 over Hiawatha (TH 55).

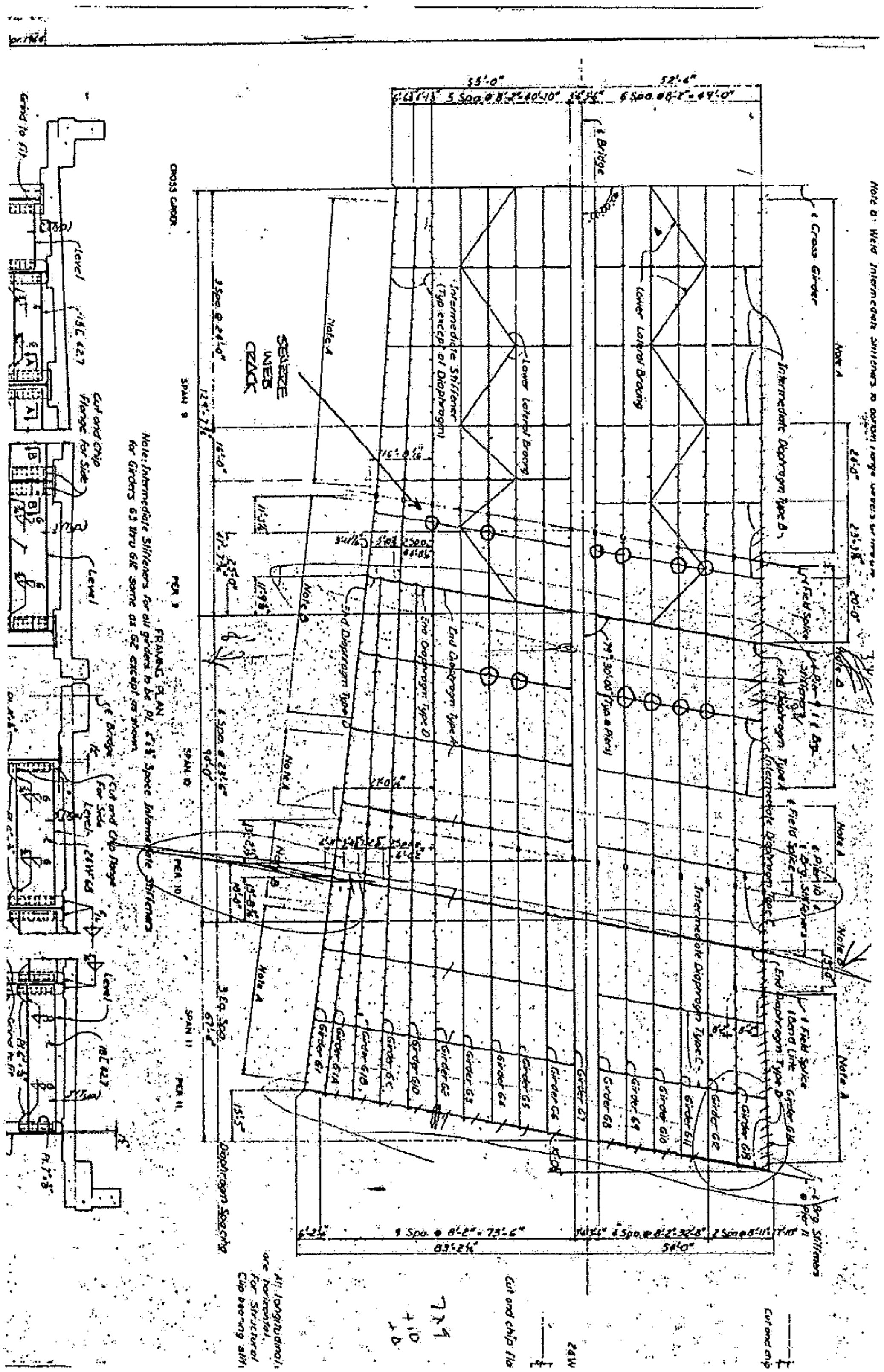
Mn/DOT constructed bridge #27855 in 1967, with seven continuous spans. The bridge was widened & re-decked in 1992. Stiffener details for the 34" & 62" welded beams, showed a "tight fit" on the tension flange. The framing plans show several areas where the diaphragms are orientated square to the beams and could be in the negative moment region. Beam lines at two locations, possibly more, terminate at header beams in near negative moment areas. We should inspect this area for stiffener / diaphragm connection weld cracks. While the beams added in 1992 presumably have bolted stiffener connections in negative moment regions, we should inspect the connections to the original fascia beams.

As a complete inspection of Br #27855 would be costly due to the lane closures required. We should first inspect those areas that we can reach without lane closures (the "gore" area toward the west end). If any fatigue cracks are found - a complete inspection would be prudent.

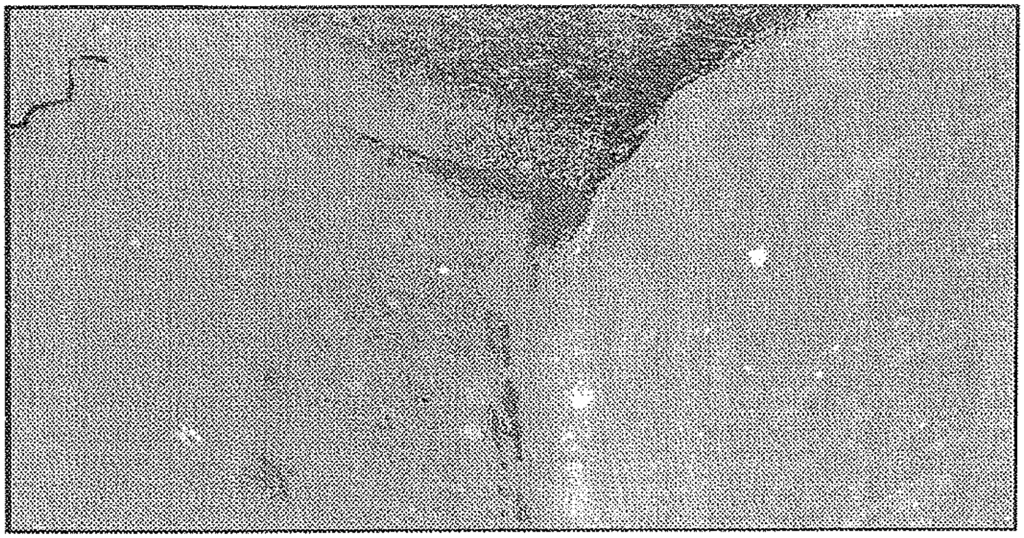
Metro Bridge Inspection is additionally requesting that, The Office of Bridges and Structures prepare recommendations for the repair of all negative moment girder / stiffener / diaphragm connections. Metro Bridge Inspection will also inspect the south stiffener / diaphragm connections of Pier # 10.

Attachments

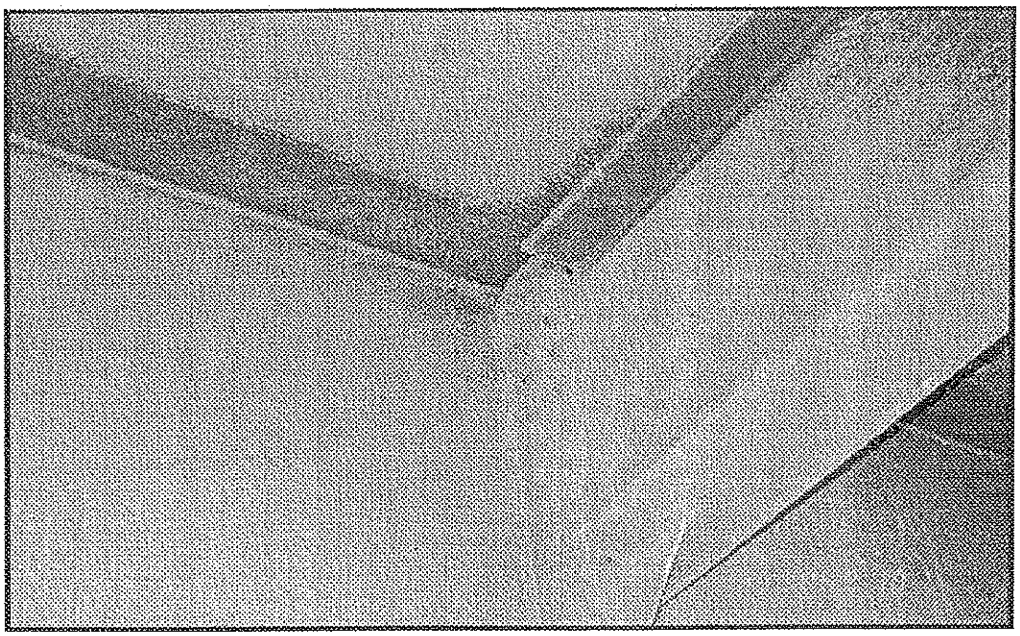
cc: Terry Zoller, Metro Maintenance
Brad Johnson, Metro Bridge Maintenance
Paul Kivisto, Office of Bridges and Structures
Lowell Johnson, Office of Bridges and Structures
Terry Moravec, Office of Bridges and Structures
Donavan Hoff, Metro Bridge Maintenance
Gary Peterson, Office of Bridges and Structures
Arlen Ottman, Office of Bridges and Structures
Todd Niemann, Office of Bridges and Structures



North Approach Spans, Weld Cracks Circled
Bridge # 9340



Br #9340
I-35W Over Mississippi River
Typical Weld Cracks on Top Web/Flange Weld
And Top Vertical Stiffener/Web Girder



Br #9340
Girder/Diaphram Connection

Minnesota Department of Transportation

Memo

Office of Bridges and Structures
Mail Stop 610
3485 Hadley Avenue North
Oakdale MN 55128-3307

Office Tel: 651/747-2101
Fax: 651/747-2109

November 3, 2000

To: Gary Workman
Metro Division, Office of Operations

From: Donald J. Flemming
State Bridge Engineer

Subject: Inspection Frequency on Br. #9330 and Br. #9340

Bridge #9330, TH 35E over the Mississippi River, and Br. #9340, TH 35W over the Mississippi River have both been inspected every 6 months because of past problems with cracking in the steel bridge members. The Metro Division Bridge Inspection Office has requested that both bridges be returned to a 12 month inspection cycle.

Bridge #9330 developed many fatigue cracks between 1995 and 1998. The ends of these cracks were contained by drilling and/or structural modifications to the details. Since 1998 no additional cracks have been noted in this bridge. We recommend that the inspection frequency be decreased to a 12 month cycle beginning with the 2001 inspection.

Bridge #9340 developed many fatigue cracks in the approach span steel girders in 1998. The ends of the cracks were drilled out and structural repairs made to the diaphragms since that time. Three existing cracks were drilled in March, 2000 but no additional cracks have been found. We recommend that the inspection frequency be decreased to a 12 month cycle beginning with the 2001 inspection.

The truss portion of Br. #9340 is fracture critical and it is important that close inspections be done on a regular basis to ensure that any problems are found as soon as possible. We recommend that a fracture critical inspection on the truss portion of this bridge be completed on a two-year frequency and that special attention be paid to fracture critical members during annual inspections. The Office of Bridges and Structures will provide fracture critical inspection assistance to the Metro Division.

Please contact us with any questions regarding these recommendations.

cc: Gary Peterson
Paul Kivisto
Jack Pirkl
Mark Pribula

Mn/DOT Agreement No. 74708
Work Order No. 124

MINNESOTA DEPARTMENT OF TRANSPORTATION
Transportation Research Investment Management Division

OFFICE OF RESEARCH SERVICES

Accounting Information:

Agency: T-79	Fiscal Year: 1999	Vendor Number: 036094001 00
Total Amount of Contract: $70,000.00	Amount of Contract First FY: $5,000.00	
Commodity Code: 030 06 000000	Commodity Code:	Commodity Code:
Object Code: 2D10	Object Code:	Object Code:
Amount: $5,000.00	Amount:	Amount:

Accounting Distribution 1:	Accounting Distribution 2:	Accounting Distribution 3:
Fund: 270	Fund:	Fund:
Appr: 209	Appr:	Appr:
Org/Sub: 6631	Org/Sub:	Org/Sub:
Rept Catg:	Rept Catg:	Rept Catg:
Amount: $5,000.00	Amount:	Amount:

Processing Information:

Contract: 423517/ 5-10-99 / klh
Number/Date of Entry/Initials

Order: 31778375 / 5-10-99 / klh
Number/Date of Entry/Initials

Budget Office: Killeen 5.14
(Authorized Signature)
[Individual signing certifies that funds have been encumbered as required by Minn. Stat. § 16A.15.]

Vendor: Office of Research Administration
University of Minnesota
Suite 201
1100 Washington Avenue South
Minneapolis, Minnesota 55415-1226

Phone: (612) 624-5066
Fax: (612) 624-4843

Vendor No.: 036 094 001 00

Attachments:

A. Special Conditions
B. Estimated Budget
C. Scope of Services

Mn/DOT Agreement No. 74708
Work Order No. 124

This work order is issued under the authority of Mn/DOT Agreement No. 74708 between the University of Minnesota (University) and the State of Minnesota, Department of Transportation (Mn/DOT), and is subject to all applicable provisions and covenants of that agreement, which are incorporated herein by this reference.

The University agrees to furnish all products and perform all services defined in this Work Order's Scope of Services and/or attachments, enclosures, or other conditions, which are incorporated by reference and made a part of this Work Order, for the consideration stated within.

PROJECT DESCRIPTION

Fatigue Assessment of Deck Truss of Bridge 9340

The deck truss of Bridge 9340 (Trunk Highway 35W over the Mississippi River) has plug welds, cover plates, and welded clips at diaphragms inside tension members, among other poor fatigue details. An analysis has shown that live-load stress ranges in the truss members are much higher than the threshold stress ranges. With 15,000 trucks per day crossing the bridge in each direction, these details should have already cracked if the stress ranges were really this high. Fortunately, when bridges are instrumented and the live-load stress ranges are measured, it is usually found that the ratio of measured stress ranges to calculated stress ranges is typically about .5 or less. If, as suspected, this is the case with Bridge 9340, the remaining fatigue life may be much longer than anticipated, and might even be considered infinite. The objective of this project is estimate the residual fatigue life of the subject bridge under projected traffic.

Begin Date: Date that all required signatures are obtained by Mn/DOT, pursuant to Minnesota Statutes Section 16C.05, subdivision 2

End Date: August 31, 2000

IN WITNESS WHEREOF, the parties hereto have caused this contract to be duly executed intending to be bound thereby.

UNIVERSITY OF MINNESOTA

By:
Kevin McKoskey
Title: Interim Assistant Director
Date: 5/11/99

DEPARTMENT OF TRANSPORTATION

By: Randall Halvorson
Title: ASSISTANT COMMISSIONER
Date: 5/12/99

COMMISSIONER OF ADMINISTRATION

ORIGINAL SIGNED BY
By: MAY 13 1999
Authorized Signature
Date: HEATHER C. PICKETT

ATTACHMENT A
SPECIAL CONDITIONS

ARTICLE I - Deliverables:

A. Reports

The Contractor shall prepare and submit the following reports to the Technical Liaison:

Report	No. of Copies	Date Due
Interim Report	5	Upon completion of Task 2
Draft Final Report for Review	5	April 30, 2000
Final Report	2 plus one camera-ready copy	August 31, 2000

B. Specifications for Reports

1. Project Updates - Mn/DOT will require an interim report upon completion of Task 2 documenting the understanding(s) reached and any issues to be resolved for continuation of the project.
2. Final Report
    - a. University shall provide two "sample" copies and one "camera-ready" copy of final report.
        - 1) The "sample" copies may be photocopied but must replicate the published form of the final report.
        - 2) "Camera-Ready" copy shall be submitted as follows:
            - a) Copy shall not be bound in any way.
            - b) Pages shall be printed on one side only.
    - b. The Principal Investigator shall follow the report format guidelines as specified in "Minnesota Department of Transportation General Guidelines for Publication of Research Reports." The Principal Investigator shall contact the Office of Research Services for a copy of the guidelines and any other report format policies.
    - c. The Principal Investigator shall submit an electronic version of the final report on disk.

C. Specifications for Software

If software is identified as a contract deliverable, the Principal Investigator shall follow the guidelines for software development specified by Mn/DOT. The Principal Investigator shall contact the Office of Research Services for additional information.

ARTICLE II - Designation of Technical Liaison:

Robert Miller, Office of Bridges and Structures, has been designated Technical Liaison for this project.

ARTICLE III - Key Personnel:

The following individual(s) shall be considered key personnel and subject to the provisions of Article XI - Change of Key Personnel of the Basic Agreement:

Principal Investigator: Robert J. Dexter, Associate Professor, Department of Civil Engineering, University of Minnesota;

Research Fellow: Paul M. Bergson, Research Fellow, Department of Civil Engineering, University of Minnesota.

ARTICLE IV - Modifications of the Basic Agreement:

None.

ARTICLE V - Budget:

Attachment B, which is incorporated by reference and made a part of this agreement, represents the approved budget for this contract.

ARTICLE VI - Payment Schedule:

Progress payments shall be made quarterly, in accordance with terms defined in the Basic Agreement, Article VI - Payments, upon receipt of invoice from the University's Office of Research Administration and shall be only for those tasks completed within the quarter.

ARTICLE VII - Other Conditions:

Mn/DOT Assistance

Mn/DOT will provide a bucket truck and a snooper truck for the duration of the instrumentation and subsequent monitoring. Mn/DOT will also provide the trucks of known axle weights, as well as any required traffic control.

ARTICLE VIII- Contract Complete:

This Work Order Contract, including all items incorporated hereinto by reference or attachment, contains all agreements and covenants between the University of Minnesota and the State of Minnesota, Department of Transportation. No other understandings, provisions, or materials, whether written, oral, or otherwise, regarding the subject matter of this Work Order Contract, shall be deemed to exist or to bind either or both of the parties hereto.

ATTACHMENT B
ESTIMATED BUDGET

ESTIMATED BUDGET BY LINE ITEM:

Salaries:		$ 47,541
Principal Investigator	$ 13,186	
Research Fellow	9,757	
Graduate Student	16,640	
Undergraduate Student	4,310	
Civil Service	3,648	
Fringe:		$ 13,813
Principal Investigator	$ 3,639	
Research Fellow	2,693	
Graduate Student	6,547	
Undergraduate Student	-0-	
Civil Service	934	
Supplies:		$ 5,826
Other Expenses:		$ 2,820
	PROJECT TOTAL	**$ 70,000**

ESTIMATED BUDGET BY PHASE:

Task 1	$ 10,000
Task 2	35,000
Task 3	20,000
Task 4	5,000
PROJECT TOTAL	**$ 70,000**

ATTACHMENT C
SCOPE OF SERVICES

FATIGUE ASSESSMENT OF DECK TRUSS OF BRIDGE 9340

BACKGROUND

The deck truss of Bridge 9340 (Trunk Highway 35W over the Mississippi River) has plug welds, cover plates, and welded clips at diaphragms inside tension members among other poor fatigue details. In addition, lack of redundancy is a major concern as there are only the two planes of the truss holding up eight lanes of traffic. A quick assessment of the details indicates that many of the details are Category D and E with threshold stress ranges of 7.0 and 5.6 ksi respectively. The analysis shows live load stress ranges in the truss members much higher than these thresholds. With 15,000 trucks per day crossing the bridge in each direction, these details should have already cracked if the stress ranges were really this high.

Fortunately, when bridges are instrumented and the live-load stress ranges are measured, it is usually found that the ratio of measured stress ranges to calculated stress ranges is typically about .5 or less. If, as suspected, this is the case with Bridge 9340, the remaining fatigue life may be much longer than anticipated, and might even be considered infinite.

RESEARCH OBJECTIVE

The objective of this project is estimate the residual fatigue life of the subject bridge under projected traffic.

SCOPE

In order to accomplish the objective, the bridge plans will be studied and a visual inspection of the superstructure will be performed, with particular attention given to the condition of the members at least partly in tension, which are subject to a large stress range. Severely corroded areas that may have lower than typical fatigue strength will be identified.

Two tension chord members at the peak positive moment region of the middle span of the truss will be instrumented as well as a floor truss. In all, at least 24 strain gages will be installed and monitored. These strain gages will be monitored while trucks of known axle weights cross the bridge. Open traffic will then be monitored for several weeks during the summer.

A ratio of the measured to calculated stress will be estimated for the components instrumented. These ratios will be applied to the calculated stress ranges at other details, and a fatigue assessment of the worst details with the highest stress ranges will be performed.

The nominal stress range for the instrumented members will be estimated as a function of axle weight and gross vehicle weight from the controlled tests. Open traffic data will then be used to characterize the stress range spectrum of typical members for current traffic. If rational estimates of past and future traffic are not available from Mn/DOT, a constant growth rate will be assumed and the stress range spectra will be extrapolated from that measured during monitoring of open traffic.

The measured strain data will be rationalized by performing an analysis of the truss. The analysis will use beam and truss elements, and local stress ranges will be estimated from the analysis results using hand calculations. Established methods will be used to perform the analysis of the residual fatigue life. The latest recommendations for the fatigue strength of connections, including the effect of corrosion, will be used. The primary deliverable will be report documenting the results of the instrumentation and monitoring, the structural analysis, and the fatigue evaluation. Specific recommendations will be made regarding the present condition, the expected future life, and the effect of increasing truck weight. The schedule is designed to yield enough information for a preliminary finding about the fatigue life of the bridge six months from the start of the work. A second deliverable will be a short report at the end of Task 2 with a specific preliminary recommendation regard the need for repair of replacement of the bridge.

WORK PLAN

Task 1 – Inspection

The bridge will be inspected and previous inspection records examined to document all poor fatigue strength details in members with fluctuating load at least partly in tension.

Duration: 3 months

Task 2 – Instrumentation

Two tension chord members at the peak positive moment region of the middle span of the truss will be instrumented as well as a floor truss. In all, at least 24 gages will be installed and monitored during test runs with a truck of known weight as well as monitoring open traffic for several weeks during summer. An interim report will be prepared at the conclusion of this task which will include specific preliminary recommendation regarding the need for repair or replacement of the bridge.

Duration: 5 months

Deliverable: Interim report

Task 3 – Analyses of Data

The strain-gage data will be processed and cycles counted.

Duration: 5 months

Task 4 – Structural Analyses

The measured strain data will be rationalized by performing an analysis of the truss. The analysis will use beam and truss elements and local stress ranges will be estimated from the analysis results using hand calculations. A ratio of the measured to calculated stress will be estimated for the components instrumented. These ratios will be applied to the calculated stress ranges at other details, and a fatigue assessment of the worst details with the highest actual stress ranges will be performed. A detailed draft final report will be submitted documenting the results of the instrumentation and monitoring, the structural analysis, and the fatigue evaluation. This report will be edited and finalized after receiving comments from Mn/DOT.

Duration: 6 months

Deliverable: Final report

PROJECT SCHEDULE

TASK	MONTH										
	1	2	3	4	5	6	7	8	9	10	11
Task 1	▨	▨	▨								
Task 2		▨	▨	▨	▨	▨					
Task 3				▨	▨	▨	▨	▨			
Task 4						▨	▨	▨	▨	▨	▨

NOTE: The expiration date of this Work Order has been extended beyond the project schedule date to provide time for review/revision of the final report.

MINNESOTA
DEPARTMENT OF TRANSPORTATION
OFFICE OF RESEARCH ADMINISTRATION
RESEARCH PROJECT WORK PLAN
3/21/95

DATE REC'D

TOC NO

CONTRACT NO

PROJ NO

FWHA NO

TITLE OF PROJECT (DO NOT EXCEED 65 TYPEWRITER SPACES).

Fatigue Assessment of Deck Truss of Bridge 9340 TH I35W over the Mississippi River

IS THIS A RESPONSE TO A SPECIFIC MN/DOT NEED? ___ NO x YES

IF YES, STATE NAME OF CONTACT PERSON FROM MN/DOT. Donald J. Flemming

PRINCIPAL INVESTIGATOR (LAST, FIRST, MIDDLE). Dexter, Robert Joseph

POSITION TITLE/DEGREES Associate Professor / Ph.D., Univ. of Texas at Austin (UT), 1992; M.S., UT, 1986; B.S., UT, 1981.

MAILING ADDRESS
Department of Civil Engineering
122 Civil Engineering Building
500 Pillsbury Drive SE
University of Minnesota - Twin Cities
Minneapolis, Minnesota 55455-0116

TELEPHONE AND FAX (AREA CODE, NUMBER, EXT.)
TEL: (612) 624-0063
FAX: (612) 626-7750

E-MAIL: dexter@tc.umn.edu

DEPARTMENT Civil Engineering

LENGTH OF PROPOSED PROJECT (MONTHS) 12

NON-MN/DOT FUNDING SOURCES
AMOUNT
SOURCE

NAME OF APPLICANT ORGANIZATION/FIRM
Regents of the University of Minnesota
ADDRESS
Office of Research and Technology Transfer Administration
1100 Washington Avenue South, Suite 201
Minneapolis, MN 55415

KEY PERSONNEL OTHER THAN PRINCIPAL INVESTIGATOR.

NAME Paul M. Bergson
POSITION TITLE Research Fellow
ORGANIZATION University of Minnesota
DEGREE(S) M.S., 1994; B.S., 1988, U of MN
ROLE ON THE PROJECT
Assist in the installation of strain measurement equipment, assist in taking all strain readings on the project, and assist in interpretation of the data.

NAME
POSITION TITLE
ORGANIZATION
DEGREE(S)
ROLE ON THE PROJECT

KEY WORDS
Fatigue, fracture, steel bridge, live load; strain gage; AASHTO

MINNESOTA DEPARTMENT OF TRANSPORTATION
OFFICE OF RESEARCH ADMINISTRATION

RESEARCH PROJECT WORK PLAN

ABSTRACT

The deck truss of Bridge 9340 has plug welds, cover plates, and welded clips at diaphragms inside tension members among other poor fatigue details. In addition, there are only the two planes of the truss holding up eight lanes of traffic, so lack of redundancy is a major concern. A quick assessment of the details indicates that many of the details are Category D and E with threshold stress ranges of 7.0 and 5.6 ksi respectively. The analysis shows live load stress ranges in the truss members much higher than these thresholds. With 15,000 trucks per day crossing the bridge in each direction, these details should have already cracked if the stress ranges were really this high.

Fortunately, when bridges are instrumented and the live-load stress ranges are measured, it is usually found that the ratio of measured stress ranges to calculated stress ranges is typically about 0.5 or less. If, as suspected, this is the case with Bridge 9340, the remaining fatigue life may be much longer than anticipated, and might even be considered infinite.

The bridge will be inspected and previous inspection records examined to document all poor fatigue strength details in members with fluctuating load at least partly in tension. Two tension chord members at the peak positive moment region of the middle span of the truss will be instrumented as well as a floor truss. In all, at least 24 strain gages will be installed and monitored during test runs with a truck of known weight as well as monitoring open traffic for several weeks during summer and another several weeks during the winter. A ratio of the measured to calculated stress will be estimated for the components instrumented. These ratios will be applied to the calculated stress ranges at other details, and a fatigue assessment of the worst details with the highest actual stress ranges will be performed.

IMPLEMENTATION *What methods, procedures, products, and/or standards should change as a result of this research project?*

This project may impact the future of Bridge 9340 and will establish fatigue evaluation methods.

What are the specific benefits of this change(s), why would this change(s) be important to Mn/DOT and/or our customer, and how can these benefits be measured?

The project may help to avoid having to replace this bridge. In addition, it will set the methods by which other existing bridges can be evaluated.

DETAILED BUDGET *DIRECT COSTS ONLY*					FROM 1 June 1999	THROUGH 31 May 2000	
PERSONNEL (APPLICANT ORGANIZATION ONLY)	PERCENT				DOLLAR AMOUNT (OMIT CENTS)		
NAME/ROLE	EFFORT ON PROJ	EMPL STATUS	CAL MTHS	EFF MTHS	SALARY/ WAGE COST	FRINGE BENEFITS	TOTALS
Robert J. Dexter Associate Professor	20%	1.0	1.75	1.75	$13,186	$3,639	$16,852
Paul M. Bergson Research Fellow	20%	1.0	2.5	2.5	$9,757	$2,693	$12,450
Graduate Student (to be named)	50%	0.5	12.0	6.0	$16,640	$6,547	$23,187
Civil Service	20%	1.0	2.5	2.5	$3,648	$934	$4582
Undergraduate Student	20%	0.5	2.7	2.7	$4,310	$0	$4,310
SUBTOTALS	130%	SUBTOTALS			$47,541	$13,813	$61,354
SUPPLIES (ITEMIZE BY CATEGORY) Laptop computer, stain gages, wire, termination box, and other replacement supplies Office supplies							$5,826
OTHER EXPENSES (ITEMIZE BY CATEGORY) Services, printing, publications, courier, postage, telephone, travel, repair							$2,820
TOTAL PROJECT COST FOR INITIAL BUDGET PERIOD (1 YEAR)							$70,000

PRINCIPAL INVESTIGATOR: I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports. Willful provision of false information is a criminal offense. I am aware that any false, fictitious, or fraudulent statement may, in addition to other remedies available to Mn/DOT, subject me to civil penalties under the Program Fraud Civil Remedies Act of 1986 (45 CFR 79). I also agree to abide by the terms of the Mn/DOT-University of Minnesota "Basic Agreement", and the task order contract for this project.	SIGNATURE OF PRINCIPAL INVESTIGATOR: (In ink. "Per" signature not acceptable). DATE: 5/4/99
CONTRACT ADMINISTRATOR: I certify that the statements herein are true and complete to the best of my knowledge, and accept the obligation to comply with the terms of any contract that may result from this application. A willfully false certification is a criminal offense. I am aware that any false, fictitious, or fraudulent statement may, in addition to other remedies available to Mn/DOT, subject me to civil penalties under the Program Fraud Civil Remedies Act of 1986.	SIGNATURE OF CONTRACT ADMINISTRATOR: (In ink. "Per" signature not acceptable). DATE: MAY 6 1999

BACKGROUND

The deck truss of Bridge 9340 has plug welds, cover plates, and welded clips at diaphragms inside tension members among other poor fatigue details. In addition, there are only the two planes of the truss holding up eight lanes of traffic, so lack of redundancy is a major concern. A quick assessment of the details indicates that many of the details are Category D and E with threshold stress ranges of 7.0 and 5.6 ksi respectively. The analysis shows live load stress ranges in the truss members much higher than these thresholds. With 15,000 trucks per day crossing the bridge in each direction, these details should have already cracked if the stress ranges were really this high.

RESEARCH OBJECTIVES

The objective of the proposed work will be to estimate the residual fatigue life of the subject bridge under projected traffic.

SCOPE

In order to accomplish the objectives, we will go over the plans and perform a visual inspection of the superstructure, particularly noting the condition of the members at least partly in tension which are subject to a large stress range. We will identify severely corroded areas that may have lower than typical fatigue strength.

Two tension chord members at the peak positive moment region of the middle span of the truss will be instrumented as well as a floor truss. In all, at least 24 strain gages will be installed and monitored. We will monitor these strain gages while trucks of known axle weights cross the bridge. We will then monitor open traffic for several weeks during summer.

A ratio of the measured to calculated stress will be estimated for the components instrumented. These ratios will be applied to the calculated stress ranges at other details, and a fatigue assessment of the worst details with the highest actual stress ranges will be performed.

We will estimate the nominal stress range for the instrumented members as a function of axle weight and gross vehicle weight from the controlled tests. We will then use the open traffic data to characterize the stress range spectrum for typical members for current traffic. If we cannot get rational estimates of past and future traffic from MnDOT, we will assume a constant growth rate and extrapolate the stress range spectra from that measured during monitoring of open traffic.

We will rationalize the measured strain data by performing an analysis of the truss. The analysis will use beam and truss elements, and local stress ranges will be estimated from the analysis results using hand calculations. We will use established methods to perform the analysis of the residual fatigue life. We will use the latest recommendations for the fatigue strength of connections including the effect of corrosion. The deliverables will include a report documenting the results of the instrumentation and monitoring, the structural analysis, and the fatigue evaluation.

TASKS AND DELIVERABLES

The total duration of the project is planned for 12 months. **The main deliverable** will be a report documenting the results of the instrumentation and monitoring, the structural analysis, and the fatigue evaluation. Specific recommendations will be made regarding the present condition, the expected future life, and the effect of increasing truck weight. The schedule was designed to yield enough information for a preliminary finding about the fatigue life of the bridge within six months from the start of the work. **A second deliverable** will be a short letter report at the end of six months (at the end of Task 2) with a specific preliminary recommendation regarding the need for repair or replacement of the bridge.

1. **Inspection**: The bridge will be inspected and previous inspection records examined to document all poor fatigue strength details in members with fluctuating load at least partly in tension.
2. **Instrumentation:** Two tension chord members at the peak positive moment region of the middle span of the truss will be instrumented as well as a floor truss. In all, at least 24 strain gages will be installed and monitored during test runs with a truck of known weight as well as monitoring open traffic for several weeks during summer. **A brief interim letter report** will be prepared at the conclusion of this task with a specific preliminary recommendation regarding the need for repair or replacement of the bridge.
3. **Analyses of data**: The strain-gage data will be processed and cycles counted.
4. **Structural analyses:** We will rationalize the measured strain data by performing an analysis of the truss. The analysis will use beam and truss elements, and local stress ranges will be estimated from the analysis results using hand calculations. A ratio of the measured to calculated stress will be estimated for the components instrumented. These ratios will be applied to the calculated stress ranges at other details, and a fatigue assessment of the worst details with the highest actual stress ranges will be performed. **A detailed draft final report** will be submitted at the end of 11 months after initiation of the contract documenting the results of the instrumentation and monitoring, the structural analysis, and the fatigue evaluation. This report will be edited and finalized after receiving comments from MinnDOT.

BUDGET BY TASK

Task 1	$10,000
Task 2	$35,000
Task 3	$20,000
Task 4	$5,000
TOTAL	$70,000

PROJECT SCHEDULE

TASK	*MONTH*											
	1	2	3	4	5	6	7	8	9	10	11	12
1	XXXXXXXXX											
2		XXXXXXXXXXXXXXXXXXXXXX										
3			XXXXXXXXXXXXXXXXXXXXXX									
4						XXXXXXXXXXXXXXXXXXXXXX						

MN/DOT ASSISTANCE

MN/DOT assistance is vital for this project to be successful. In addition to providing guidance on this project through periodic technical committee meetings, the following assistance is requested of MN/DOT:

1. It is understood that MinnDOT will provide a bucket truck and snooper truck for the duration of the instrumentation and subsequent monitoring. MinnDOT will also provide the trucks of known axle weights as well as any required traffic control.

LITERATURE REVIEW

The fatigue evaluation of existing bridges is covered in several past and ongoing studies for NCHRP. In addition, there is an AASHTO guide specification for the fatigue evaluation of existing bridges.

ROBERT J. DEXTER
Associate Professor of Structural Engineering
Department of Civil Engineering, 500 Pillsbury Drive S.E.
University of Minnesota, Minneapolis, Minnesota 55455

EDUCATION

1992 Ph.D. in Civil Engineering, The University of Texas at Austin

1986 M.S. in Civil Engineering, The University of Texas at Austin

1991 B.S. in Civil Engineering, with Highest Honors, The University of Texas at Austin

PROFESSIONAL CAREER

8/97	Associate Professor, Department of Civil Engineering University of Minnesota, Minneapolis, Minnesota
8/91-8/97	Senior Research Engineer, ATLSS Engineering Research Center Lehigh University, Bethlehem, Pennsylvania
6/81-8/91	Senior Research Engineer, Materials and Mechanics Division Southwest Research Institute, San Antonio, Texas

PROFESSIONAL SOCIETY MEMBERSHIPS AND SELECTED COMMITTEE ASSIGNMENTS

American Society of Civil Engineers (ASCE), Structural Engineering Institute (SEI), Member.

- Chairman (1997-), ASCE Committee on Fatigue and Fracture
- Chairman (1996-), ASCE Committee on Metal Materials (Materials Division)

American Welding Society

SELECTED PUBLICATIONS

"Fatigue and Fracture", by R.J. Dexter and J.W. Fisher, Section 20, The Structural Engineering Handbook, W.F. Chen, ed., CRC Press Inc., 1997.

"Fatigue and Fracture", by R.J. Dexter and J.W. Fisher, Chapter 8, Steel Design Handbook, LRFD Method, McGraw-Hill, 1997.

"Field Study of Pretension in Large Diameter A490 Bolts", by C.J. Oswald, R.J. Dexter, and S.K. Brauer, ASCE Journal of Bridge Engineering, Vol. 1, No. 3, August 1996.

"Full-Scale Experiments and Analyses of Cellular Hull Sections in Compression, by R.J. Dexter, J.M. Ricles, L.-W. Lu, A.A. Pang, and J.E. Beach, ASME Journal of Offshore Mechanics and Arctic Engineering, Vol. 118, No. 3, Aug. 1996.

"High Performance Steel for America's Bridges", by J.W. Fisher and R.J. Dexter, Welding Journal, Vol. 73, No.1, pp. 35-43, January 1994.

"Predicting Extensive Stable Tearing in Structural Components", by R.J. Dexter and M.L. Gentilcore, Fracture Mechanics, 29th Volume, ASTM STP 1391, T.L. Panontin and S.D. Sheppard, Eds., American Society for Testing and Materials, Conshohocken, PA, 1998.

"Through-thickness Properties of Heavy Welded Steel "T" Joints", by R.J. Dexter and M. Melendrez, Proceedings of the Structural Engineers World Congress, 19-23 July 1998, San Francisco, CA

"Local Web Crippling of Unstiffened Multi-Cell Box Sections", by M.R. Kaczinski, C.R. Schneider, R.J. Dexter, and, L.-W. Lu, Proceedings Structures Congress 94, Atlanta, GA, April, 1994, Vol. 1, pp. 343-348, 1994.

9340_prs.doc

MINNESOTA DEPARTMENT OF TRANSPORTATION
OFFICE OF BRIDGES AND STRUCTURES

BRIDGE PRESERVATION RECOMMENDATIONS

BRIDGE NO. 9340

RDWY. AREA
(Sq. Ft.) 201,511 T.H. 35W OVER Mississippi River in Mpls DIST. NO. Metro
Length 1907.0' Span Lengths 14 spans Rdwy. Width 52.0'; 52.0' Type 404; 401
Other Features

Tentative Letting Date March 23, 2007
Current ADT 121,000
Bridge Designer Arlen Ottman
Year Built 1967
Appr. Pavement Concrete
Inventory Ratings: Existing HS 20.0
Appr. Shoulder Concrete
After Reconstruction HS

Scope of Work	Recommendations By Bridge Engineer		
	Yes	No	Comment
Overlay			
a) 2" low slump concrete	X		B-1
b) Other (See comments)		X	
Slab Preparation			
a) Scarifying 2.0 in. conc. (sq. ft.)	X		B-2
b) Removal to top of rebars (sq. ft.)	X		B-3
c) Removal to below top rebars (sq. ft.)		X	
d) Full depth removal (sq. ft.)	X		B-4
e) Dust Control		X	B-5
f) Other (See comments)	X		B-6
Railing			
a) Replace		X	
b) Reconstruct (to meet 10 kip)		X	
c) Repair	X		B-7
d) Protective Screening Requested by district		X	
e) Other (See comments)		X	
f) Existing railing presently meets 10 kip loading	X	X	B-7
Joints			
a) Install new waterproof devices	X		B-8
b) Other	X		B-9
Substructure Repair			
a) Bearings		X	
b) Other		X	

BRIDGE NO. 9340

Scope of Work	Recommendations By Bridge Engineer Yes	No	Comment
Drainage Modifications			
a) On bridge		X	
b) Off bridge		X	
Approach Modifications			
a) Tapers		X	
b) New panels		X	
c) Treatments		X	
d) Relief Joints		X	
e) Guard Rails			B-10
f) Slope Protection		X	
Estimated Cost			
a) Less than 30% of cost of a new bridge	X		B-13
Loop Detection Systems			
a) Are any visible on bridge		X	
b) Are any visible on approach panels		X	

Based on a recent field review of the above referenced bridge, the above procedures are recommended by:

Paul M Kurisko, Metro Region Bridge Engineer Date: 9/14/06

Approved ____________, State Bridge Engineer Date: 9/18/06

Traffic Control (District to indicate method only if traffic will not be carried during reconstruction)

	Yes	No	Comment
a) By pass or detour		X	B-11

The District concurs in all Bridge Office recommendations except as noted on this form. District comments:

Approved ____________, for District Engineer Date: 10/1/06

[illegible]
[illegible] Action [illegible]
[illegible] 2" of [illegible], not
for [illegible]
[illegible]

B-1) Br. #9340 carries TH 35W over the Mississippi River in Minneapolis. The bridge has 3 main spans consisting of a steel continuous deck truss and 11 steel continuous beam approach spans. The bridge was built in 1967 and has uncoated reinforcement bars in the deck. A 2" low slump concrete overlay was added to the bridge in 1978 at which time extensive full depth repairs were completed. According to a 1999 ground penetrating radar survey the deck is 6% unsound. A deck chaining survey in 2006 found approximately 7% patched and/or unsound concrete. There are more than 3000 linear feet of transverse cracks in the deck. There are moderate amounts of transverse cracks with efflorescence and spalling on the bottom of the deck. We recommend that the entire low slump overlay be removed, deck repairs completed, and a new low slump overlay placed on the deck and the approach panels on each end of the bridge. High Early Strength concrete may be required to minimize cure time depending on traffic control needs. The deck shall be diamond ground for texture. Replacement of loop detectors in the approach panels will be included in the roadway plans.

B-2) The entire 2" thick low slump concrete overlay will be removed by milling.

B-3) 8% of the deck area shall be included for Type 1 deck repairs down to the top mat of rebars.

B-4) In the event deeper delamination is found, 1% of the deck area shall be included for Type 3 deck repairs.

B-5) Dust control procedures per special provision BS2ME-2404.1 shall be followed.

B-6) There are many anti-icing spray disks that are embedded in the deck. Provisions for replacing the disks and associated tubing and hardware as necessary will be provided in the contract. Metro shall provide details and specifications for this work. Coordinate disk installation with diamond grinding on deck.

B-7) The outside concrete barriers were retrofitted in 1998. The rails meet current standards. The curbs were not repaired at that time and have areas of spalling and delamination. The unsound areas in the curb shall be removed and patched, estimated quantity 50% of the curb length.

B-8) Strip seal joints were installed at 7 locations in 1978 and have several areas of leakage. New strip seal expansion devices shall be provided at the joints at each abutment and the other strip seal joint locations in the bridge. The open finger joints at the ends of the deck truss and the span 2 hinge will remain inplace.

B-9) The poured type joints in the approach panels shall be resealed per spec 3723. The type E8 joints at the ends of the approach panels shall be resealed. Type E8S joints will be included in the bridge plans.

B-10) Guardrails attach to all approach corners of the bridge, to the southwest corner leaving the bridge, and to the concrete median barrier on each end of the bridge. We understand that new concrete median barriers will be provided north of the bridge as part of a separate grading contract, but no new median barriers will be provided to the south of the bridge. The bridge designer shall coordinate median barrier details with the District. Per meeting in the field with Metro Roadway Design, new guardrail anchors will be grouted into the inplace rails as part of the grading plan.

B-11) The District shall develop traffic control plans for this project.

Other information

B-12) The joints between the slope paving and the abutments shall be resealed. Metro shall comment if they desire any repairs to the slope paving at the river.

B-13) This work does not address the poor rating of the superstructure. URS has completed the draft final report on the Fatigue Evaluation and Redundancy Analysis of Br. #9340, and based on the recommendations in the draft report we recommend that Metro program truss member retrofit plating work within the next 4 years. Rehabilitation of the four rocker bearings on the transfer beams that support the approach spans on the cantilever truss spans should also be programmed.

ArchiveManager

From: Roger Schultz **Sent:** Fri, 24 Feb 2006 08:37:07 GMT

To: Jack Pirkl; Mark Pribula;

CC: John Howard

Subject: Fwd: Br. #9340 meeting

9340_prs.doc (41472Kb)

Jack & Mark - FYI -- Roger S --

>>> Paul Kivisto 02/24/06 08:11AM >>>
Geoff,
I have written a preliminary recommendation (see attachment) for replacing the overlay on Br. #9340, TH 35W over the Mississippi River. I know there has been a lot of talk about future options for work on this bridge, and it would be good to have a meeting to discuss those options prior to finalizing the recommendation. I tried to set up a meeting in Waters Edge but I can't figure out how to schedule the Waters Edge Conference rooms, plus I don't know for sure who should attend from Metro Design. So could you please arrange a meeting in the next month or so for the following list of attendees:
Paul Kivisto, Gary Peterson, Jack Pirkl, Roger Schultz, Mark Pribula, plus whoever is appropriate in Metro design - probably Geoff Prelgo, Tom O'Keefe, John Griffith and maybe Jerome Adams.
I did a busy search for this list and it looks like we may need to go out as far as March 28 to get a date that fits around vacations and meetings for the various people.

Please give me a call to discuss as needed.
Thanks!
Paul

MINNESOTA DEPARTMENT OF TRANSPORTATION
OFFICE OF BRIDGES AND STRUCTURES

PRELIMINARY BRIDGE PRESERVATION RECOMMENDATIONS

BRIDGE NO. 9340

RDWY. AREA
(Sq. Ft.) 201,511 T.H. 35W OVER Mississippi River in Mpls DIST. NO. Metro
Length 1907.0' Span Lengths 14 spans Rdwy. Width 52.0'; 52.0' Type 404; 401
Other Features

Tentative Letting Date January 26, 2007
Bridge Designer Arlen Ottman
Appr. Pavement Concrete
Appr. Shoulder Concrete

Current ADT 121,000
Year Built 1967
Inventory Ratings: Existing HS 20.0
After Reconstruction HS

Scope of Work	Recommendations By Bridge Engineer		
	Yes	No	Comment
Overlay			
a) 2" low slump concrete	X		B-1
b) Other (See comments)		X	
Slab Preparation			
a) Scarifying 2.0 in. conc. (sq. ft.)	X		B-2
b) Removal to top of rebars (sq. ft.)	X		B-3
c) Removal to below top rebars (sq. ft.)		X	
d) Full depth removal (sq. ft.)	X		B-4
e) Dust Control		X	B-5
f) Other (See comments)	X		B-6
Railing			
a) Replace		X	
b) Reconstruct (to meet 10 kip)		X	
c) Repair	X		B-7
d) Protective Screening Requested by district		X	
e) Other (See comments)		X	
f) Existing railing presently meets 10 kip loading	X	X	B-7
Joints			
a) Install new waterproof devices	X		B-8
b) Other	X		B-9
Substructure Repair			
a) Bearings		X	
b) Other		X	

BRIDGE NO. 9340

Scope of Work	Recommendations By Bridge Engineer Yes	No	Comment
Drainage Modifications			
a) On bridge		X	
b) Off bridge		X	
Approach Modifications			
a) Tapers		X	
b) New panels		X	
c) Treatments		X	
d) Relief Joints		X	
e) Guard Rails			B-10
f) Slope Protection		X	
Estimated Cost			
a) Less than 30% of cost of a new bridge	X		B-13
Loop Detection Systems			
a) Are any visible on bridge		X	
b) Are any visible on approach panels		X	

Based on a recent field review of the above referenced bridge, the above procedures are recommended by:

______________________, Metro Region Bridge Engineer Date: ______________________

Approved ______________________, State Bridge Engineer Date: ______________________

Traffic Control (District to indicate method only if traffic will not be carried during reconstruction)

	Yes	No	Comment
a) By pass or detour		X	B-11

The District concurs in all Bridge Office recommendations except as noted on this form. District comments:

Approved ______________________, District Engineer Date: ______________________

B-1) Br. #9340 carries TH 35W over the Mississippi River in Minneapolis. The bridge has 3 main spans consisting of a steel continuous deck truss and 11 steel continuous beam approach spans. The bridge was built in 1967 and has uncoated reinforcement bars in the deck. A 2" low slump concrete overlay was added to the bridge in 1978 at which time extensive full depth repairs were completed. According to a 1999 ground penetrating radar survey the deck is 6% unsound. There are more than 3000 linear feet of transverse cracks in the deck. There are moderate amounts of transverse cracks with efflorescence and spalling on the bottom of the deck. We recommend that the entire low slump overlay be removed, deck repairs completed, and a new low slump overlay placed on the deck. High Early Strength concrete may be required to minimize cure time depending on traffic control needs. The deck shall be diamond ground for texture.

B-2) The entire 2" thick low slump concrete overlay will be removed by milling.

B-3) 8% of the deck area shall be included for Type 1 deck repairs down to the top mat of rebars. To get a better estimate of amount of unsound deck to include in the cost estimates we recommend that Metro provide chain drag information or ground penetrating radar results as possible.

B-4) In the event deeper delamination is found, 1% of the deck area shall be included for Type 3 deck repairs.

B-5) Dust control procedures per special provision BS2ME-2404.1 shall be followed.

B-6) There are many anti-icing spray disks that are embedded in the deck. Provisions for replacing the disks and associated tubing and hardware as necessary will be provided in the contract. Metro shall provide details and specifications for this work.

B-7) The outside concrete barriers were retrofitted in 1998. The rails meet current standards. The curbs were not repaired at that time and have areas of spalling and delamination. The unsound areas in the curb shall be removed and patched, estimated quantity 25% of the curb length.

B-8) Strip seal joints were installed at 7 locations in 1978 and have several areas of leakage. New strip seal expansion devices shall be provided at the joints at each abutment and the other strip seal joint locations in the bridge. The open finger joints at the ends of the deck truss and the span 2 hinge will remain inplace.

B-9) The poured type joints in the approach panels shall be resealed per spec 3723. The type E8 joints at the ends of the approach panels shall be resealed. Bridge designer to coordinate E8 joint work with the roadway plans.

B-10) Guardrails attach to all approach corners of the bridge, to the southwest corner leaving the bridge, and to the concrete median barrier on each end of the bridge. We understand that new concrete median barriers will be provided north of the bridge as part of a separate grading contract, but no new median barriers will be provided to the south of the bridge. The bridge designer shall coordinate median barrier details with the District.

B-11) The District shall develop traffic control plans for this project.

<u>Other information</u>

B-12) The joints between the slope paving and the abutments shall be resealed. Metro shall comment if they desire any repairs to the slope paving at the river.

B-13) This work does not address the poor rating of the superstructure. Prior to final recommendation a meeting will be scheduled to discuss future work needed to raise the condition rating above NBI 4.

Responses to Mn/DOT Comments on Bridge 9340 Draft Report

1. Basic Information on Material Properties

Comment:

[GDP] Page 1 first paragraph. - is anything known about toughness of the steel used. Some discussion of unknown toughness may bear on rate of crack growth and time to react to initial crack discovery.

Response:

We did search for material properties, such as mill test reports, in the data collection task, but could not locate any data on material sample tests for strength or toughness.

We may take another try to look for original material test reports, with the cooperation of Mn/DOT staff. However, the likelihood of finding steel toughness test data in the early 1960's may be slim.

Another option is to remove some samples and send them to a lab for CVN impact tests. We can identify some steel plates that do not carry any load but have the same specified properties as those of most interest. Material toughness is definitely very valuable information for decisions on retrofit strategies.

2. Strength Evaluation, Force Interaction Ratio, and Load Ratings

Comment:

[GDP] Page 3 2nd paragraph. What was the allowable stress for steel tension or compression members compared to yield. Is the last sentence true that with a design ration of 1.004 any bending moments would likely cause localized overstress in relation to operating or inventory bridge rating criteria. Clarification give us some feeling for remaining safety factors for occasional over legal loads.

[GDP] In the following discussion, clarify that ultimate capacity is the yield capacity of the member.
The paragraph states the force interaction ratio for unfactored loads never exceeded 1.0. What would be an acceptable interaction ration at an operating rating? How often is that interaction ratio exceeded?

[GDP] Do we address what the operating rating of this bridge is based on the analysis? Based on what we know, we may want some discussion about permitting trucks somewhere between inventory and operating rating.

[DLD] Strength Evaluation Page 5: The second paragraph notes that no interaction ratios greater than 1.0 were found using the unfactored load and the ultimate capacity. Assuming some were close to 1.0, does this mean no traditional safety factor remains and there is no residual capacity beyond the design live loads?

<u>Response:</u>

The original truss bridge was designed in accordance with the 1961 AASHO (Allowable Stress Design) considering axial load only. Section 1.4.2 Structural Carbon Steel stipulates that the structural steel is AASHO M 94 (ASTM A7) that has a yield strength of 33,000 psi. The allowable stress was specified for tension as 18,000 psi ($0.55F_y$) for net section; and for compression members as $15{,}000 - ¼\,L^2/r^2$ psi for riveted ends with $L/r \leq 140$.

Contract B plans (Sheet 20 of 94) tabulate for all truss members the Effective Gross Area (subtracting the perforations) and the Net Area (further subtracting the bolt/rivet holes).

Most main truss members were made of high strength structural steel of 50 ksi yield strength. The allowable stresses used in the original design were (Sheet No. 2 of 94, Contract B plans):

MHD 3306:	F_s=20 ksi	F_y=36 ksi	F_u=58 ksi
MHD 3309:	F_s=27 ksi	F_y=50 ksi	F_u=70 ksi (Thickness > ¾")
MHD 3310:	F_s=27 ksi	F_y=50 ksi	F_u=70 ksi (Thickness ≤ ¾")

In the original design, it appears that the design of tension members was based on an allowable stress of $0.55F_y$ for the net section per the 1961 specs. According to current AASHTO Standard Specifications, tension members are to be designed for an allowable stress of $0.55F_y$ for gross section or $0.46F_u$ for net section (subtracting bolt holes), whichever is lower.

For compression members, we compared the 1961 allowable stress with the current AASHTO allowable stress and found that allowable stresses for concentrically loaded columns from both specs are relatively close. The allowable compressive stress from the current specs tends to be lower than the 1961 specs, and the difference increases as the slenderness ratio increases. The slenderness ratio of all main truss members varies between 49 and 106 (Contract B plan sheet 20), except that diagonal U2-L3 (a stress reversal member) has an L/r ratio of 135.

Example 1. Lower Chord L7-L8 (compression member, F_y=50 ksi, L/r = 56):
Per 1961 AASHO specs, compression allowable stress in column is:

$(F_s)_c = 15{,}000(F_y/33{,}000) - ¼\,(L/r)^2$, for $L/r \leq 140$
$= 15{,}000(50/33) - ¼(56)^2 = 22{,}727 - 784 = 21{,}943$ psi

Per current AASHTO specs, compression allowable stress in column is:

$(F_s)_c = 23{,}580 - 1.03(KL/r)^2$, for $L/r \leq 107$
$= 23{,}580 - 1.03(0.75 \times 56)^2 = 23{,}580 - 1{,}817 = 21{,}763$ psi (0.8% lower)

Example 2. Vertical U7-L7 (compression member, F_y=50 ksi, L/r = 106):
Per 1961 AASHO specs, compression allowable stress in column is:

$(F_s)_c = 15{,}000(F_y/33{,}000) - \frac{1}{4}\,(L/r)^2$, for $L/r \leq 140$

$= 15{,}000(50/33) - \frac{1}{4}(106)^2 = 22{,}727 - 2809 = 19{,}918$ psi

Per current AASHTO specs, compression allowable stress in column is:

$(F_s)_c = 23{,}580 - 1.03(KL/r)^2$, for $L/r \leq 107$

$= 23{,}580 - 1.03(0.75 \times 106)^2 = 23{,}580 - 6{,}510 = 17{,}070$ psi (14.3% lower)

Using the 1961 allowable stresses, we determined the truss member axial capacities (not listed in the plans) and calculated a "design ratio" to be the ratio of member axial load (listed in the stress sheet) over the calculated allowable axial capacity. The design ratios were close to 1.0 for many main truss members with the highest being 1.004 for diagonal L9'-U8' (in tension). These findings indicate that the original design was very tight for the allowable stresses as used.

Additionally, for the design of trusses, both the 1961 Section 1.6.7 Secondary Stresses and the current AASHTO Standard Specifications Section 10.16.3 Secondary Stresses have the same provisions: *"The design and details shall be such that secondary stresses will be as small as practical. Secondary stresses due to truss distortion or floor beam deflection usually need not be considered in any member, the width of which, measured parallel to the plane of distortion, is less than one-tenth of its length. If the secondary stress exceeds 4,000 pounds per square inch for tension members and 3,000 for compression members, the excess shall be treated as a primary stress."* The current AASHTO specs have the following additional sentence that was not in the 1961 version: *"Stresses due to the flexural dead load moment of the member shall be considered as additional secondary stress."* Apparently, the original design of Bridge 9340 assumed that the secondary stresses were below 4,000 psi.

Our computer model simulates the actual process of truss assembly and the three dimensional interaction between all structural components, which results in unintended global composite action in carrying the live load between the floor system (deck and stringers) and the truss system (main trusses, floor trusses and all other bracing members). The results of our 3-D analysis have indicated: (1) the camber process induces permanent "residual" forces in truss members, primarily in bending; (2) for dead load forces in truss members, the 3-D model agrees well with the original design stress sheet in axial forces but with significant bending moments in some members; (3) for live load forces in truss members, the 3-D model predicts lower axial forces but with significant bending moment in some members. The discrepancy is primarily resulted from 3-D analysis of the structural system vs. 2-D analysis of individual components. The concentrated loads from the approach spans at both cantilevered ends of the truss spans also cause significant member bending in localized areas.

To simulate the cambering process, we took the actual length adjustments of the main truss and the floor truss members specified in the shop drawings, and input these as member axial distortion load. The resulted deformed shaped of our model was in agreement with the camber diagram of the truss specified in the contract plans. At the end of the cambering process, all truss members are distorted subject to bending moments and axial forces since the members are forced to fit into the joint gusset plates that have bolt holes drilled based on the final geometry. A generally accepted convention has been that after all the dead loads are applied the truss system would deflect to the desired geometry and the member distortions would disappear. Thus all truss members would be under axial load only because the dead load induced truss member end moments would counteract and cancel those induced by the cambering process. Obviously this objective is very difficult to be materialized since the traditional planar analysis cannot accurately predict member length changes and there are many sources of approximations in the fabrication process. Therefore keeping the truss members slender is one way to control the undesirable bending moments. Interestingly and not surprisingly, we discovered that the cambering process of Bridge 9340 does induce significant "residual dead load bending moments" for some members.

We also found significant bending moments in some truss members under dead and live loads because the truss system was made a space frame with rigid connections and has many unintended composite actions among its structural components. Many truss members, especially the verticals, have several intermediate joints that are framed to the floor truss, the portal truss, or the lateral bracing members. The truss system also has transverse deck expansion joints around which the stringers are connected differently (fixed bearings on one side and expansion bearings on the other side) to the floor truss. This feature causes significant out-of-plane bending of the floor truss top chord under the longitudinal shear between the stringer and the floor truss resulting from the global bending of the truss-deck system. The unintended global composite action between different structural layers of truss bridges has been recognized as a main reason for connection fatigue problems in many other major bridges across the country.

In summary, what we've discovered is that many truss members on Bridge 9340 are likely experiencing high localized stresses due to combined axial and bending actions, compared with the design criteria (not the yield strength of steel). However, the design criteria of ASD, LFD and LRFD are all satisfied under the axial load alone, without considering the bending effect. Since the truss system is a highly indeterminate system, its tolerance to localized overstress due to bending or even the formation of plastic hinges should be high, similar to a rigid frame system for buildings where plastic hinges are allowed as long as no mechanism is formed (unstable structural system). Therefore, it is true that we don't have much safety margin for local stresses but on the other hand the overall stability of the structural system is not easily jeopardized although difficult to quantify. As we mentioned in the report, a force interaction ratio exceeding 1.0 does not necessarily indicate a section failure but rather a localized overstress per design criteria. Steel, with the yielding plateau, is a forgiving material for the formation of local plastic hinges in an indeterminate structural system because of load redistribution. It is critical, however, to ensure the satisfaction of axial capacity of truss members. Additionally, our analysis has indicated that no force interaction ratios exceed 1.0 using the unfactored LRFD design load (heavier than the original design load with greater impact) and the ultimate section capacities. This indicates little chances for actual occurrence of localized steel yielding or formation of plastic hinges.

For tension members, the LFD force interaction ratio per AASHTO Guide Specifications for Strength Design of Truss Bridges, is calculated as:

$$\frac{P}{(F_y)(A_n)}+\left[\frac{M}{(S_n)(F_y)(f)}\right]_{(in-plane)}+\left[\frac{M}{(S_n)(F_y)(f)}\right]_{(out-of-plane)}\leq 1.0$$

or

$$\frac{P}{(F_u)(A_{\bar{n}})}+\left[\frac{M}{(S_{\bar{n}})(F_u)(f)}\right]_{(in-plane)}+\left[\frac{M}{(S_{\bar{n}})(F_u)(f)}\right]_{(out-of-plane)}\leq 1.0$$

where, each term is always positive and represents the contribution of axial or bending in each principal direction.

$F_yA_n = P_y$ = axial yield strength of member section (with perforations removed)

$S_nF_yf = F_yZ = M_z$, plastic moment of member section

In pure axial tension, an unstable member failure would occur when the axial load reaches the yield strength of the section, i.e., when $P=P_y$. Under the combined action of axial load and bending moments, $R \geq 1.0$ does not necessarily indicate an unstable member failure but rather a localized overstress in accordance with the design criteria. If M_y is used in the equation instead of M_z, only one point at one of the four corners of the member section reaches yield under the combined loads when $R = 1.0$. When M_z is used, however, a value of $R \geq 1.0$ indicates a localized area more than just a point. The exact extent of local yielding and its impact on the load-carrying capacity of the section depends on the composition of the three components that make up the R. There is little or no reserve capacity or traditional factor of safety in the system based on the AASHTO Guide Specifications for Trusses and the equations noted above.

In terms of load ratings for overweight vehicles, the AASHTO Load Factor Ratings for Operating Level is to reduce the live load factor from 2.18 to 1.3 compared with the Inventory Level. If we follow the truss Guide Specs, perhaps we could calculate the combined force interaction ratio using a live load factor of 1.3 instead of 2.18 for overweight vehicles and consider that to be comparable to the Operating rating.

Comment:

[GDP] Page 4, first paragraph: Have you confirmed from shop drawings that the bridge was actually built cambered to the theoretical no load condition?

Response:

We were able to verify that the member length adjustments in the shop drawings would generate truss camber in agreement with the camber blocking diagram specified in the contract plans. A construction inspector could have, or should have, checked the actual truss camber against the camber blocking diagram on the plans. The "no load condition" is difficult to be verified without performing strain gage measurements. What our analysis indicated is that some truss members were under high bending moments after all dead loads were in place, which is different from the original intent of the truss design.

Comment:

[GDP] Page 4 center paragraph, 1st sentence: #) LRFD factored load and ultimate capacity???

Response:

The "LRFD factored load and capacity" intends to represent the LRFD factored load and the LRFD nominal resistance, which is the ultimate capacity adjusted by the LRFD resistance factors. The combined force interaction ratio was calculated for this case and two other cases: one for unfactored load and ultimate capacity, and the other for LFD factored load and ultimate capacity. These interaction ratios were then compared with the design ratio, which is the ratio of the axial load from the original design stress sheet to the allowable axial strength of the truss member. Each of these cases represents the safety margin based on the design criteria of the original design (ASD axial stress only), LFD force interaction ratio, and LRFD force interaction ratio, respectively, except that the "unfactored load and ultimate capacity" case measures the actual stress condition with respect to the ultimate capacity.

3. Fatigue Evaluation

Comment:

[GDP] Page 6 paragraph 1, first sentence: "determined to have theoretically infinite fatigue life"???

Response:

My copy of the report does not have the word "theoretically". Nevertheless, what it means is that the infinite fatigue life requirements of the LRFR and the Fatigue Guide Specifications are both satisfied using the theoretically calculated stress ranges from the 3-D computer model. Another theoretical assumption is that the maximum stress range to be experienced by a bridge over its design life is two times the stress range calculated using the fatigue truck. The experimental fatigue research results provide "constant amplitude fatigue limit (CAFL)" for each fatigue detail category for loading stresses ranges below which no fatigue crack growth is expected.

Using the LRFR criteria, the calculated stress range from the 3-D model due to a single fatigue truck is multiplied by a "stress range estimate partial load factor" of 0.95. The factored stress range is then multiplied by 2.0 for the maximum expected stress range, (Δf)max, at the fatigue detail. The (Δf)max, found to be the highest at 3.10 ksi in all truss members with the Category D detail, is well below the CAFL of Category D at 7.0 ksi.

Somebody may argue that this estimated maximum stress range (two times the single fatigue truck induced stress range) may not be conservative enough for this 8-lane bridge. The University of Minnesota performed field strain gage measurements in 1999 using controlled test load and under normal traffic. Under the controlled test load, a maximum tensile stress range of 1.9 ksi was reported in a main truss lower chord under a total of nine trucks closely spaced in a 3x3 formation; and 4.1 ksi in a floor truss lower chord under a total of six closely spaced test trucks with a group of three crawling in the left lane of each direction of traffic. Under open traffic monitoring over a four-month period, the maximum recorded stress range was found to be 1.9 ksi in the truss lower chord and 3.8 ksi in a diagonal of the floor truss.

The Fatigue Guide Specifications is more conservative than the LRFR. The single fatigue truck induced stress range calculated from the 3-D model is first multiplied by a reliability factor of 1.68 for non-redundant members. The factored stress range is then compared with a limiting stress range of 2.6 ksi for Category D detail (0.375 times CAFL). The highest value of the factored stress range was found to be 2.58 ksi, just satisfying the infinite fatigue life requirement.

Comments:

[DLD] Fatigue Evaluation Page 9: Various members are described in the text and tables, such as U0)-U1 Upper Chord, etc. Within the Executive Summary, if would be beneficial to have a truss diagram. At times, only the Executive Summary would be reprinted for others to read. It should stand alone without needed the full report to clarify.

Response:

Agree. We will add a truss elevation labeling all the panel points so that all main truss members will be clearly designated.

Comments:

[DLD] Fatigue Evaluation Page 10: The last paragraph states failure of five of the eight critical members would "cause instability of the structural system". For others in Mn/DOT

that are not knowledgeable in structures this phrase may not be understood. If the conclusion is the instability would likely lead to collapse of the bridge, that should be stated clearly.

Response:

Agree. We will clarify by using the words "possible collapse" in lieu of "instability".

4. Retrofit Concepts and Deck Replacement

Comment:

[GDP] Page 10 last paragraph: For the plate retrofit option, was a computer model generated to determine if force effects are concentrated at the ends of the plate members? It seems the moment deformations might be magnified in the unplated axial member located between the last bolt in the gusset plate connection and the first bolt in stiffened axial member??

I may be mistaken but I thought the contract asked for some analysis of contingency repairs. There should be some discussion of using the retrofit concepts as contingency repairs, or others should be discussed in more detail. Perhaps they are in subsequent sections.

One concept discussed by the District is to purchase plates and bolts for one or two member repairs during the overlay contract to be installed as a repair should a short un repairable crack be discovered during inspections. Would one size plate work for any repair, assuming it would be cut to length in the future. Would it be possible to pre drill the plates in a pattern that would work for all without significantly reducing the strength of the plate if only the required bolts holes were filled?
Is it feasible to make emergency repairs a tension member under traffic, or from above the member, or would that repair need to be made from below. Is the repair feasible from below assuming the cracks may occur during winter months when barges may not be used?

Its likely that retrofit of main members may be postponed for 15-20 years once an overlay is placed next year. Indepth weld inspections would continue to made every 5 years on the critical members indicated in this report and a visual arms length inspection of the critical members would be made every year.

Response:

To be discussed in the meeting.

Comment:

[DLD] Retrofit Concepts Page 11: The first paragraph begins with; "Another retrofit strategy..." and discusses replacing the existing deck with a continuous deck. Some may

conclude this is an alternate to the steel plating strategy. Suggest the sentence begin with: "In addition to the steel plating concept, replacing the existing deck.....etc."

Response:

Agree. We will make modifications per suggestions.

Comment:

[DLD] Retrofit Concepts Page 12: The paragraph at the top of the page ends with the sentence; "The amount of longitudinal deck reinforcement above Piers 6 and 7 shall be carefully determined in the final design of deck replacements." What specifically is the writer thinking when this caution is given to a future designer. Please elaborate on the aspects you believe the designer must consider.

Response:

Currently the floor system, made of the deck and stringers, has transverse expansion joints at piers and near the mid-span locations. As a result, the tension in the negative bending areas (above the piers) is entirely resisted by the upper chords of the main trusses. Our analysis has indicated that a continuous deck would help reduce live load stresses in most truss members (especially the top truss chords above piers) and improve redundancy of the truss system. This requires that the floor system (deck and stringers) above the piers be designed properly to resist the portion of tension above the truss top chords. The sizing and detailing of the reinforcement in the replacement deck as well as the stringer connections above the piers should be properly addressed in the final design of deck replacement. If the replacement floor system is expected to resist the tension upon the possible failure of a truss top chord above the pier, it should be designed accordingly. Additionally, a continuous deck will change the truss member forces since it becomes a different composite structural system. Most truss members will experience lower forces but there are exceptions where some truss members will see higher forces. All these issues will need to be considered in the re-decking design.

Comment:

[DLD] Conceptual Plan for Deck Replacement Page 13: The last sentence of the first paragraph notes if the unbalanced half deck procedure is considered, a detailed analysis should be performed during final design. This decision is critical to our future project planning. One of the outcomes expected from the study was an assessment of the redecking options and traffic maintenance. We need this key question answered at this time, how many lanes can be maintained and what should be the staging, either half at a time, middle rebuilt first, or outside redecked first? This same issue appears is Recommendation 4. Without this answer, the staging for the entire project and roadway is stalled. So it cannot wait for final design.

Response:

Our 3-D model indicated that a half-deck truss system carrying four lanes of live load, with the other half of the deck and stringers completely removed, is subject to no higher member forces compared with the full-deck system carrying eight lanes of traffic load. This is based on an analysis of the force interaction ratio of the main truss and floor truss members. Based on the transverse load distributions as shown in Table 4-2, the main truss members should not be subject to higher loads when half of the deck is removed. The main objective of the analysis was to examine the floor truss members and connections under the unbalanced dead and live loads that tend to cause the highest differential deflection between the two main trusses. Our analysis has found no worse condition, in terms of the combined force interaction ratio, with such deck replacement scheme. However, we still recommend that the floor truss members and connections be carefully checked in the final design of the deck replacement design. We are also looking into the stability of the half-deck system under wind, for which the worse condition is when one lane of live load is applied to the outer lane on the deck cantilever.

5. Recommendations

Comment:

[DLD] Recommendations Page 13: Within the recommendations, the summary of the fatigue life should be reiterated. In short, it appears the likelihood of a fatigue failure is low. However, due to the lack of access in the box members, crack initiation or growth cannot be monitored. Therefore, if a crack occurs, it could easily go undetected and result in a sudden failure. For those reasons, a retrofit is recommended.

Response:

Agree. We will modify the report accordingly.

Comment:

[DLD] Additionally, we should discuss the timing of the retrofit, urgency, and agree upon language for the Executive Summary. A natural question will be when these retrofits are needed and can they coincide with other work.

Recommendation 2 states an internal inspection should be conducted of critical members. Is it even possible to get an inspector within arms length of the internal diaphragms? If only camera access is possible this leaves no opportunity to clean away rust scale and perform the necessary NDT.

We should discuss these items at the meeting.

6. In Individual Sections

Section 1- Introduction

Comment:

[GDP] Page 1 last sentence: Category E not B

Response:

Agree. We will change in the final report.

Section 2 Bridge Inspection and Data Collection

Comment:

[GDP] Page 6 first paragraph, first sentence: Do we really want a recommendation that specifically requires the tab welds to be inspected on a yearly basis. What is the basis for the recommendation.

An initial inspection schedule has been discussed that will open the access holes on identified critical members to do an up close inspection of tab welds every 5 years, and an arms length visual inspection of the exterior surface yearly, and a routine snooper visual inspection of all other tension members on a yearly basis.

Is the recommendation relevant to the scope of work of the study? Should it be deleted? If relevant, would it be sufficient to recommend that Mn/DOT establish an arms length visual inspection schedule for critical members to provide early detection of crack formation at tab welds.

Response:

To be discussed in the meeting.

Comment:

[GDP] Page 7 - Section 2.3.1. Is the reported crack in a critical, highly stressed, or fatigue prone member?

Metro: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

Response:

To be discussed in the meeting.

Comment:

[GDP] Page 8 - Section 2.3.3 . Is the reported crack in a critical, highly stressed, or fatigue prone member?
Metro: Are the cracks being monitored on each inspection,? Are there plans to repair the cracks?

Response:

To be discussed in the meeting.

Comment:

[GDP] Page 9 - Section 2.3.6: was the transfer floor beam at the junction of the truss and approach span determined to be a critical member: Has retofit or freeing of these bearings been discussed or recommended in other sections. No recommendation concerning freeing these bearings is listed in the executive summary.

Response:

To be discussed in the meeting.

Comment:

[GDP] Page 23 last paragraph. - Good data. Does the fatigue analysis section discuss the significance of over 17 million fatigue cycles on the bridge. Does the number of cycles indicate that if flaws were present they should have caused cracking by now, and the absence of crack history or findings indicate a low probability of future cracking based on calculated fatigue stresses. Ie do we have some confidence that the absence of major flaws then increases the probability of infinite fatigue life?

Response:

Given the service history of the bridge and the study results on loading stresses, it is reasonable to conclude that the probability of fatigue cracking in the truss chords is very low. This also agrees with the findings from the fatigue evaluation per AASHTO specifications as discussed previously. However, there is a factor of uncertainty in the change of material toughness with aging. For example, why did the Hoan Bridge fracture occur thirty years after its opening in a day that was not the coldest and the loading that was not the heaviest in its service history? We also observed two other girder fractures (unstable crack growth) from fatigue susceptible details in two other bridges, one in Pennsylvania and one in Maryland. These fractures also occurred under normal traffic load decades after the bridge began to carry traffic. One can explain why the fractures occurred where they occurred because there are poor details that cause stress concentration. However, so far no one can explain why some fractures happened after so many years of service without visible signs of fatigue on the fracture surface. As we learned from probability and statistics, a zero-probability event may still happen.

Section 4 Strength Evaluation of Truss Members

Comment:

[GDP] Page 2 Explain the that eq 4.1 is used for gross section calculations and 4.2 is used for net? Or what ever the difference is.

Response:

We will clarify.

Comment:

[GDP] Page 4 bottom of page: is "this has been ..." a note that is meant to be deleted?

Response:

We will fix it in the final report.

Comment:

[GDP] Page 19 bottom of page: is it LRFD factored load and ultimate capacity?

Response:

As discussed before, the "LRFD factored load and capacity" intends to represent the LRFD factored load and the LRFD nominal resistance, which is the ultimate capacity adjusted by the LRFD resistance factors.

Section 5 Fatigue Evaluation of Truss Members

Comment:

[GDP] All AASHTO fatigue evaluations show theoretical infinite life

Section 5.5 Page 11 second paragraph: Some discussion of unknown toughness should be added to reasons for not discounting concern if cracks are present. Maybe some discussion of how toughness affects the speed of crack growth.

Response:

To be discussed in the meeting and we will try to address this in the final report.

Section 6 Structural Redundancy Analysis

Comment:

[GDP] Section 6.1 Page 2 - Define CAFL and the significance that with three fatigue trucks the stress range for no no truss member significantly exceeds half of the CAFL

Response:

To be discussed in the meeting and we will address this in the final report.

Comment:

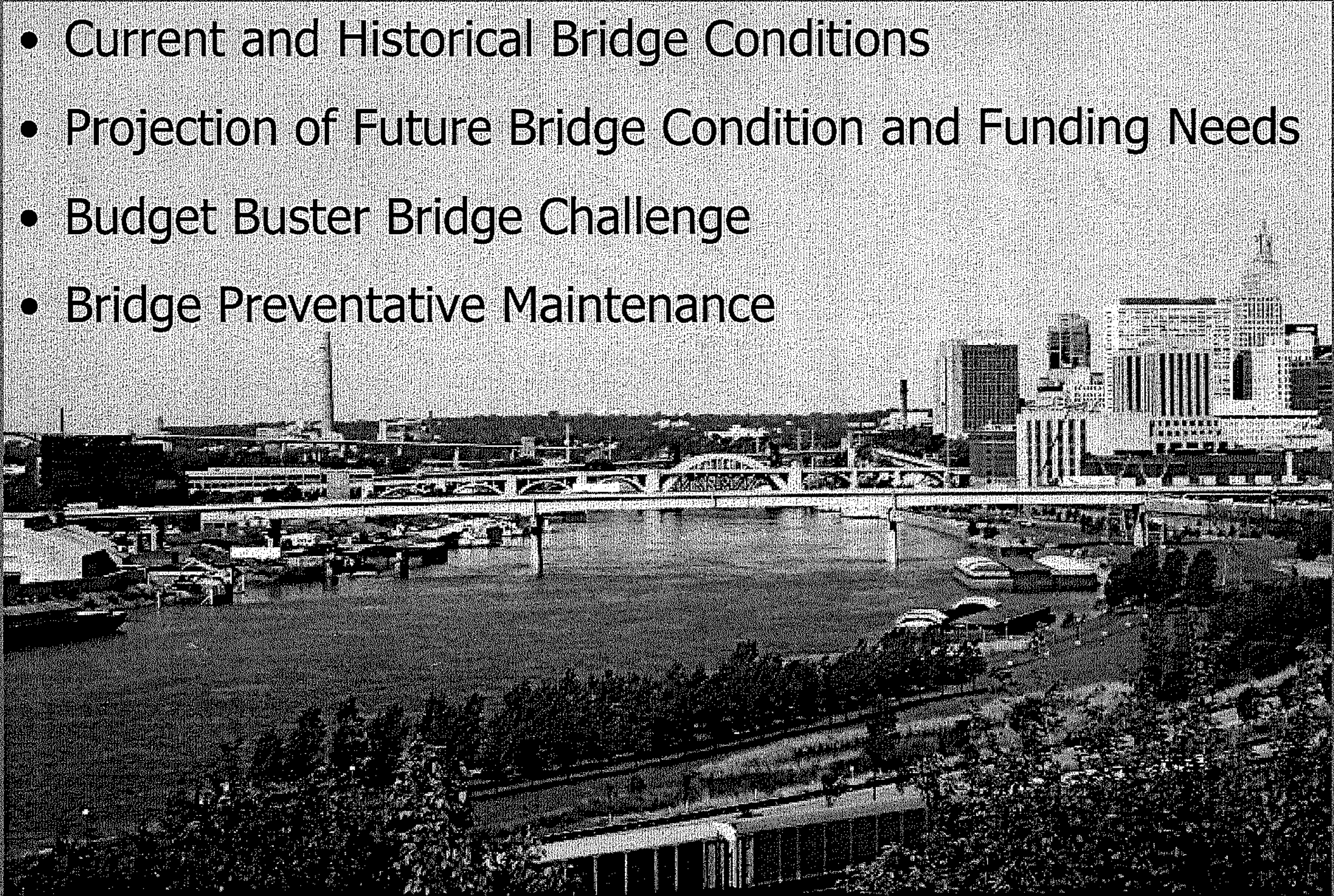
[GDP] Section 6.4 page 9:
Informational comment: The discussion states that the NCHRP 406 analysis provides a comprehensive measure of bridge redundancy, from which persuadably some level of confidence or concern about a formation of a collapse mechanism could be concluded. Mn/DOT chose not to calculate this measure, and instead chose to assume members would fail, and then to consider the consequence of that failure.

It would informative to have run through that analysis. Does the consultant have a feeling for what that analysis would have shown? I assume due to the low stresses in the truss, the analysis would have shown the bridge had a high level of reliability.

Response:

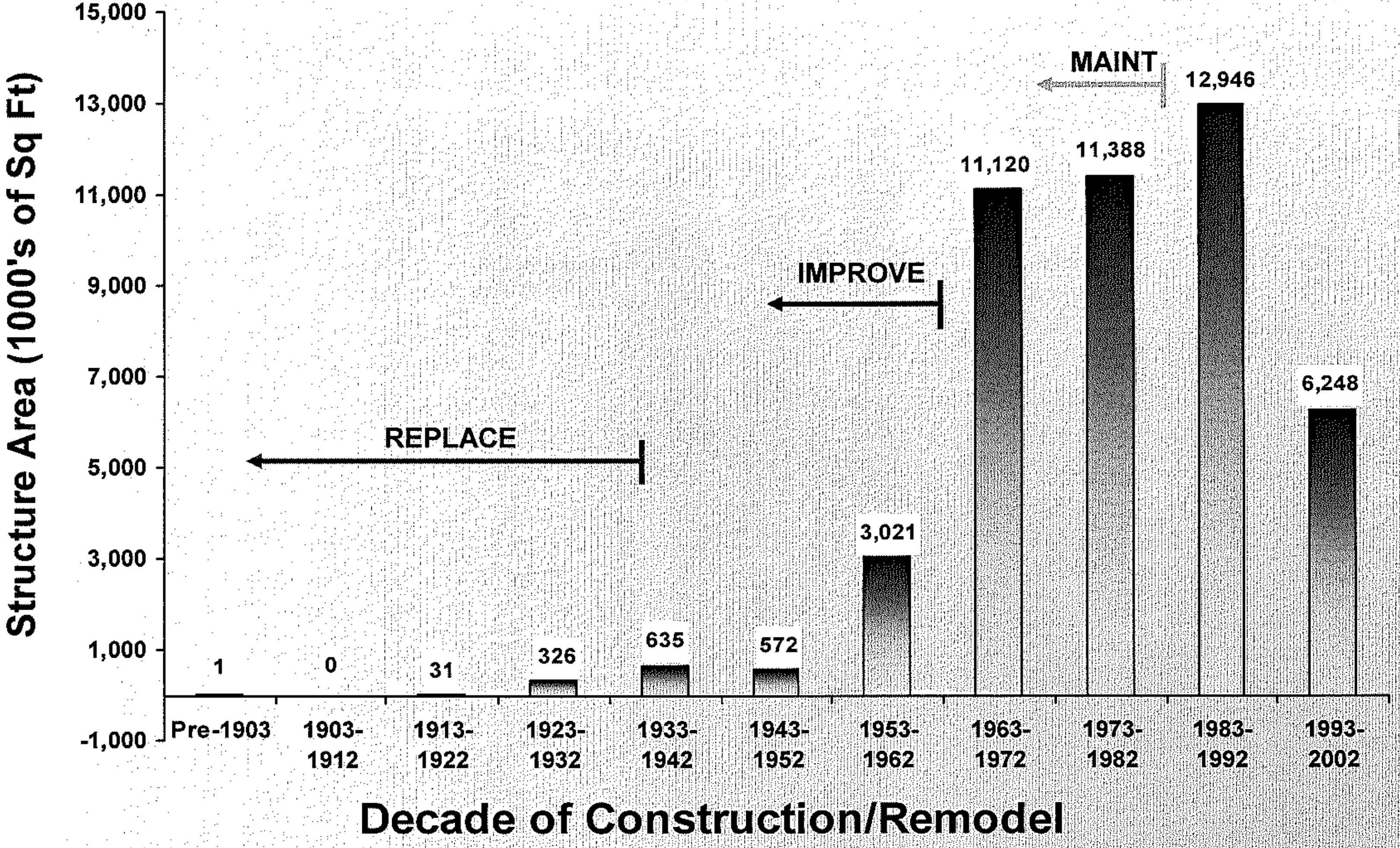
To be discussed in the meeting and we will address this in the final report.

Report for Commissioner's Staff Meeting
April 5, 2004



- Current and Historical Bridge Conditions
- Projection of Future Bridge Condition and Funding Needs
- Budget Buster Bridge Challenge
- Bridge Preventative Maintenance

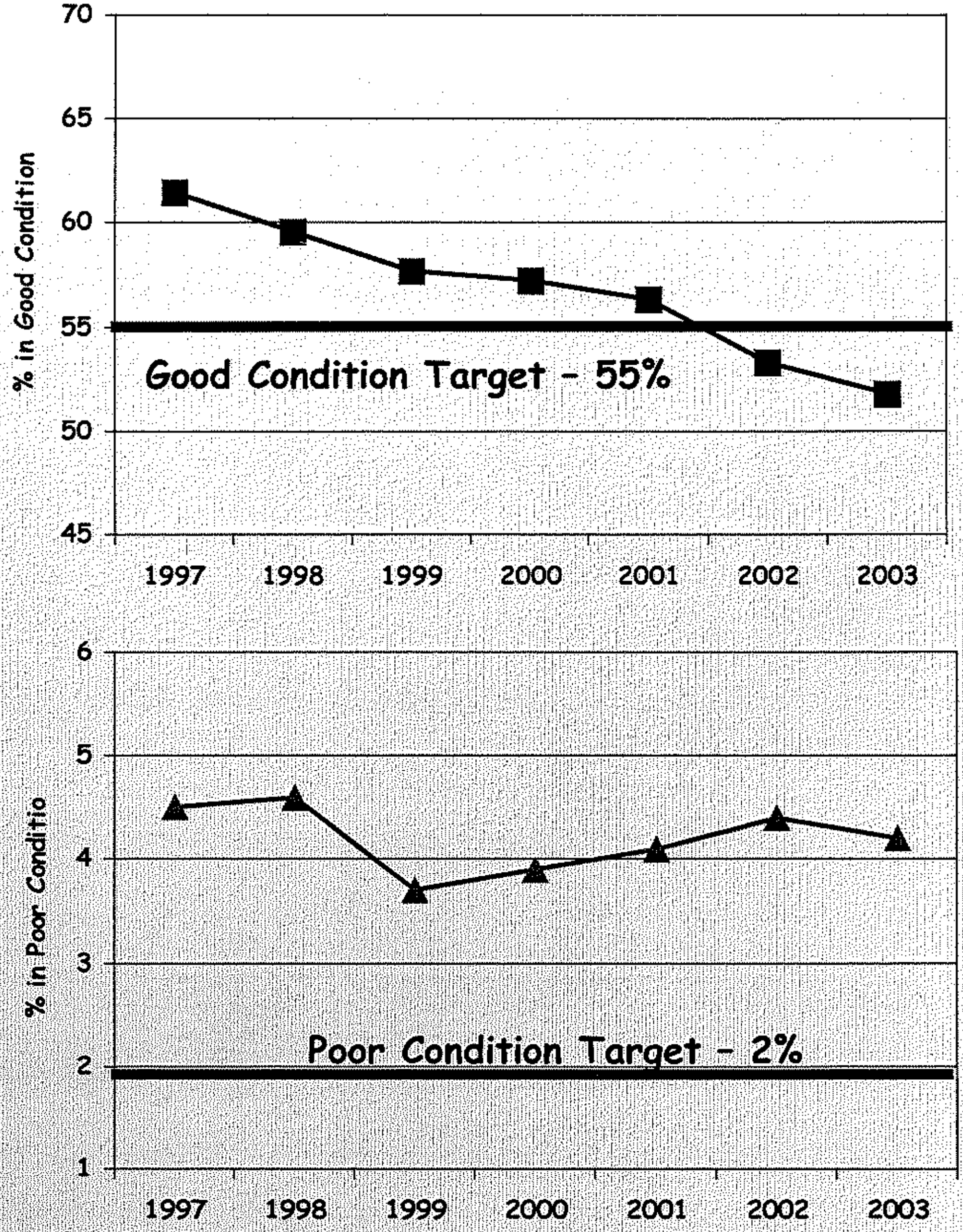
AGE PROFILE BY AREA OF STRUCTURES
TRUNK HIGHWAYS ONLY
4429 STRUCTURES 10 FT AND OVER
2003

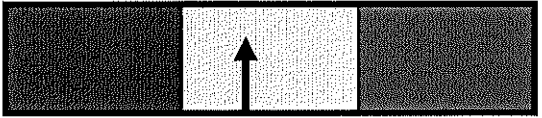


Improvement = Overlay, Paint, Replace Joints, Replace Deck, etc.

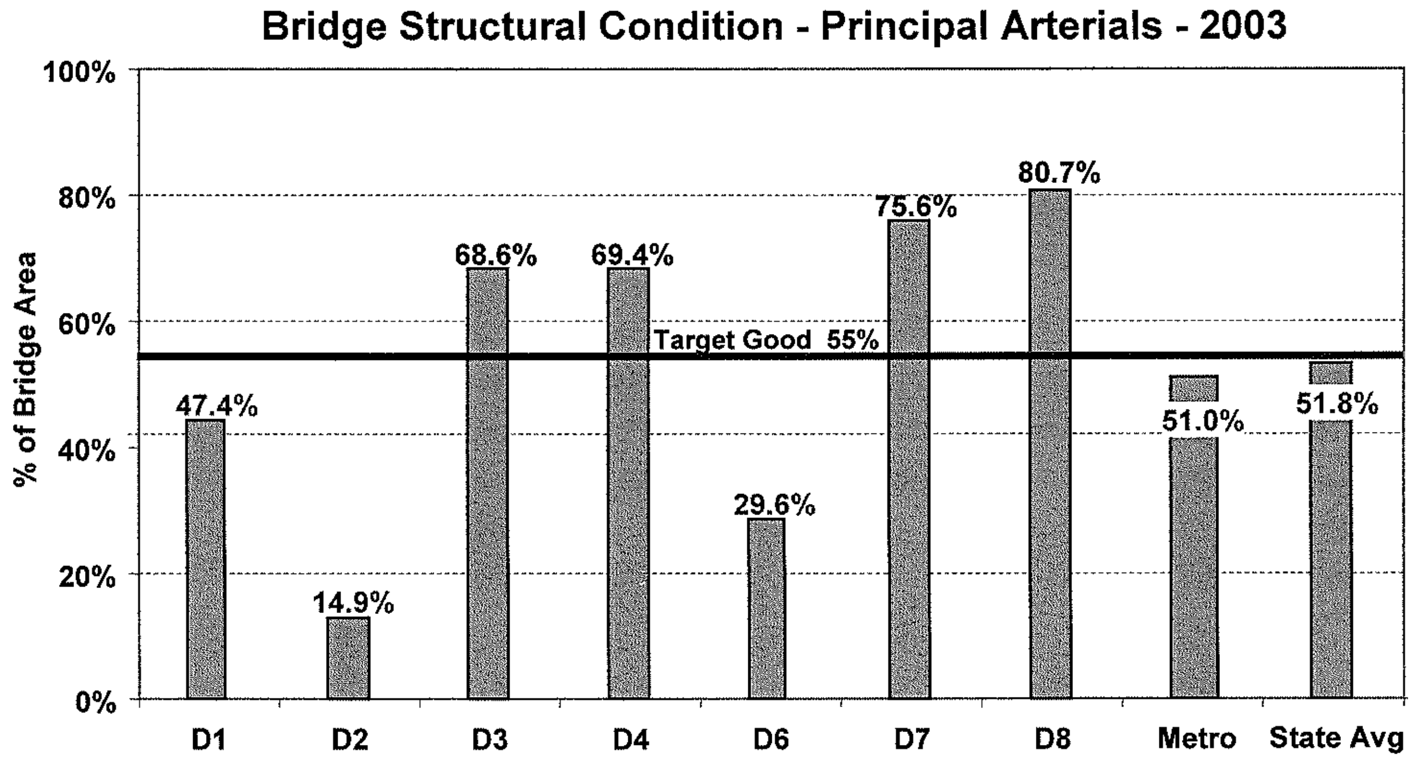
STATEWIDE

Trunk Highway Principal Arterial Bridges (20′ and Over) Structural Condition Performance Target (Percentage by Area)

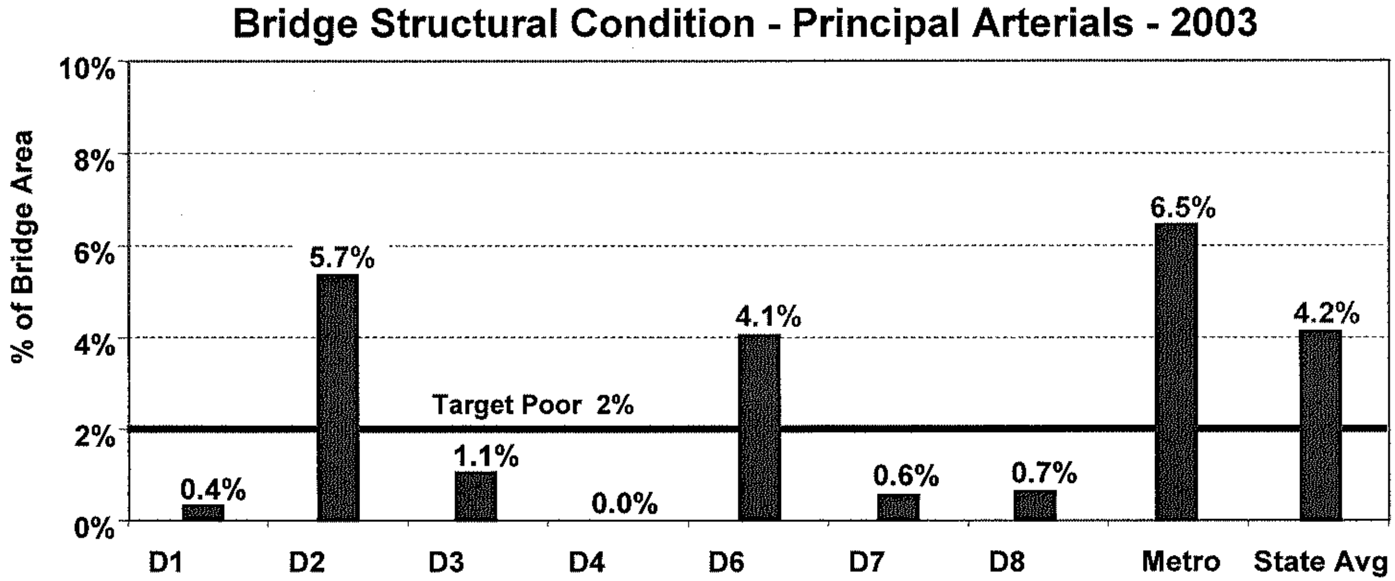




December, 2003



Bridge Structural Condition - Principal Arterials - 2003



Bridge Structural Condition - Principal Arterials - 2003

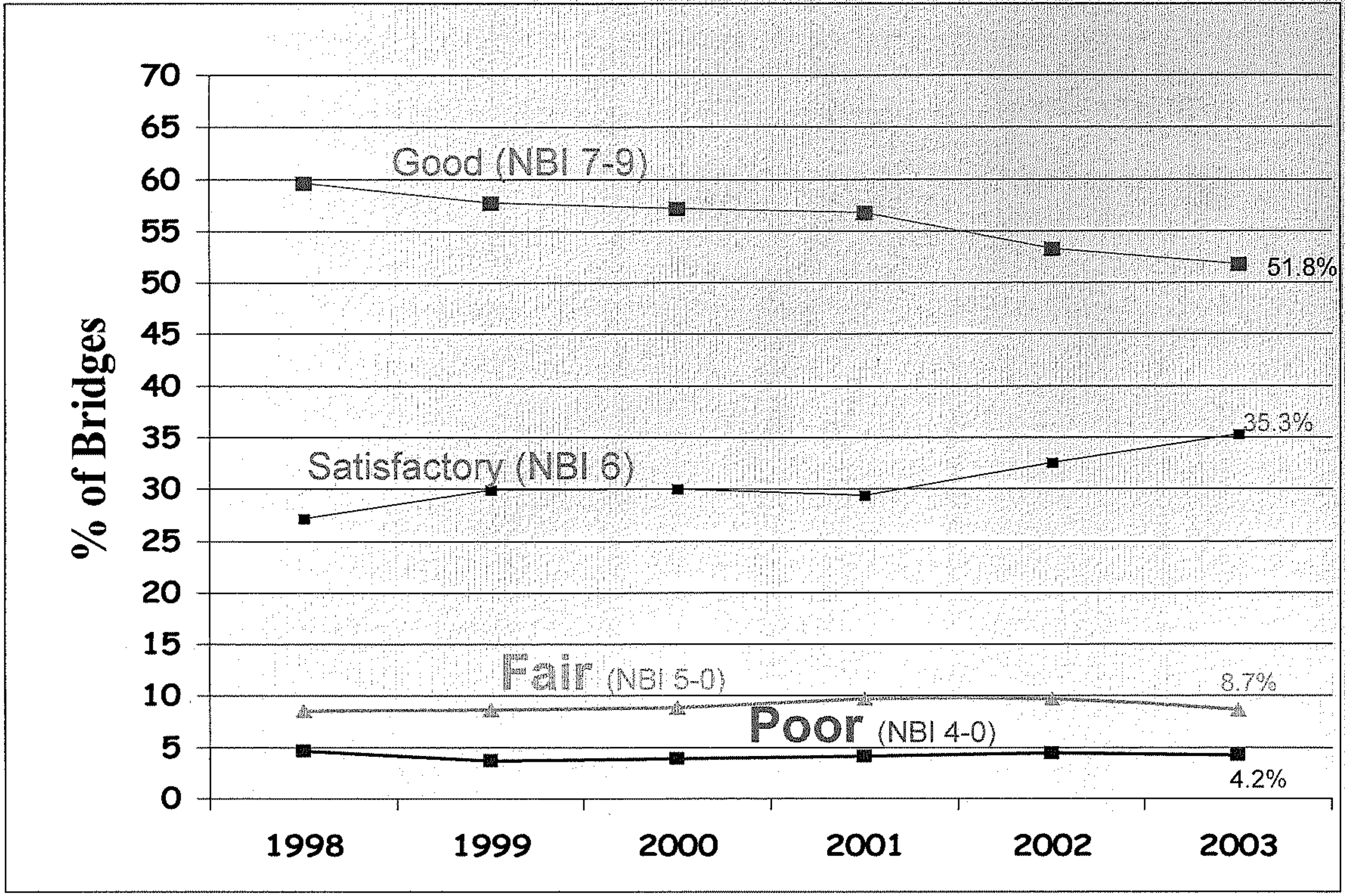
Performance Summary

- Bridges on Principal Arterial Classified Highways = 84% of all Bridges
  - Statewide Averages Do Not Meet Good Target of Greater Than 55% or Poor Target of 2% or Less.
  - Only Districts 3, 4, 7 & 8 Meet Both Good and Poor Targets
  - Bridges in Good Condition Continue to Decline As the System Ages and System Expansion Rates Slow From Interstate Era.
- Bridges on Minor Arterial, Collector/local Classified Highways = 16% of All Bridges
  - Statewide Condition Averages Meet Both Good and Poor Targets
  - Targets for Good and Poor Bridges Are Less Stringent for Minor Arterial and Collectors

STATEWIDE BRIDGE CONDITION

TRUNK HIGHWAY PRINCIPAL ARTERIAL

20' and Over

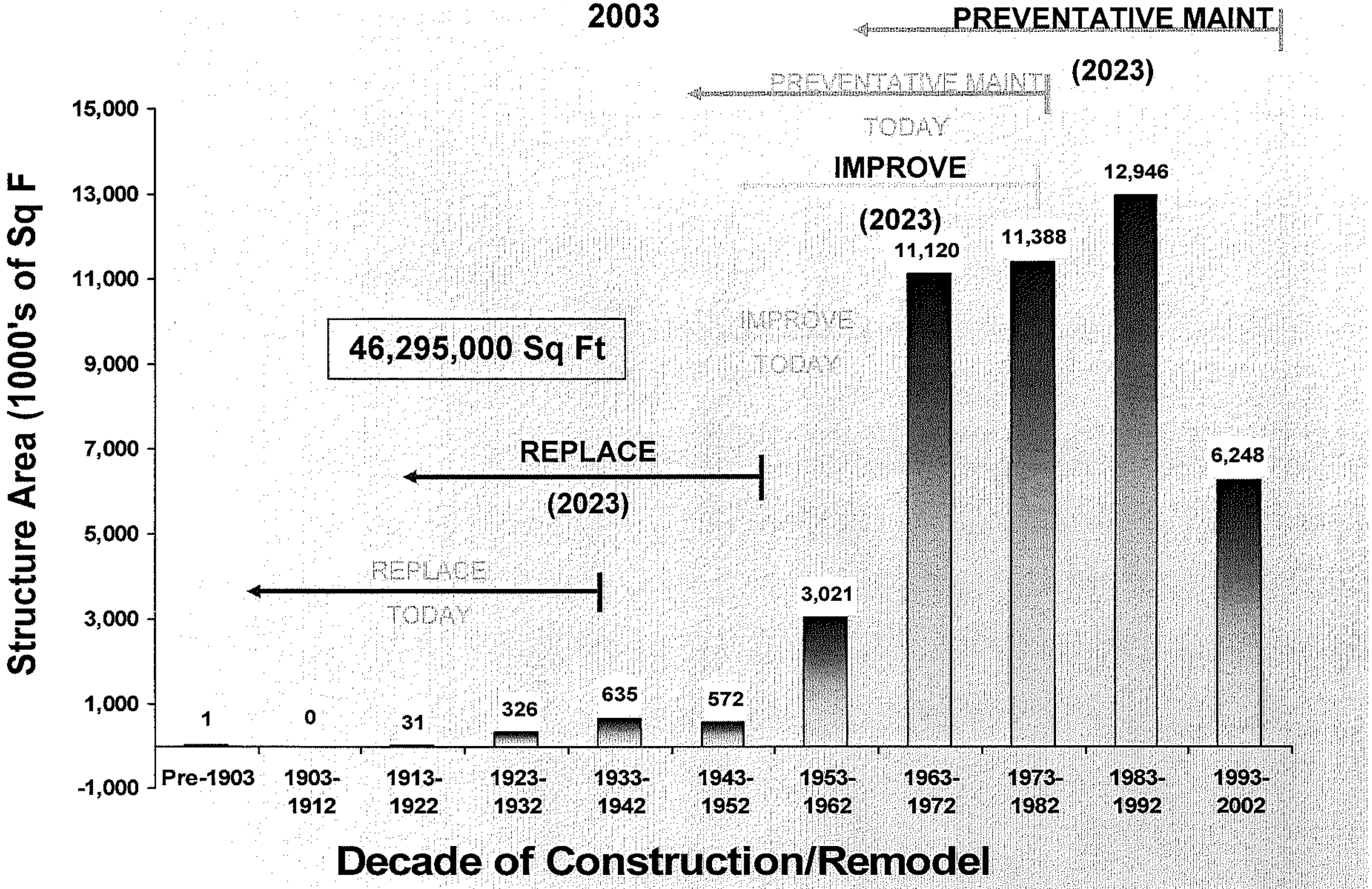


Future Performance Tracking

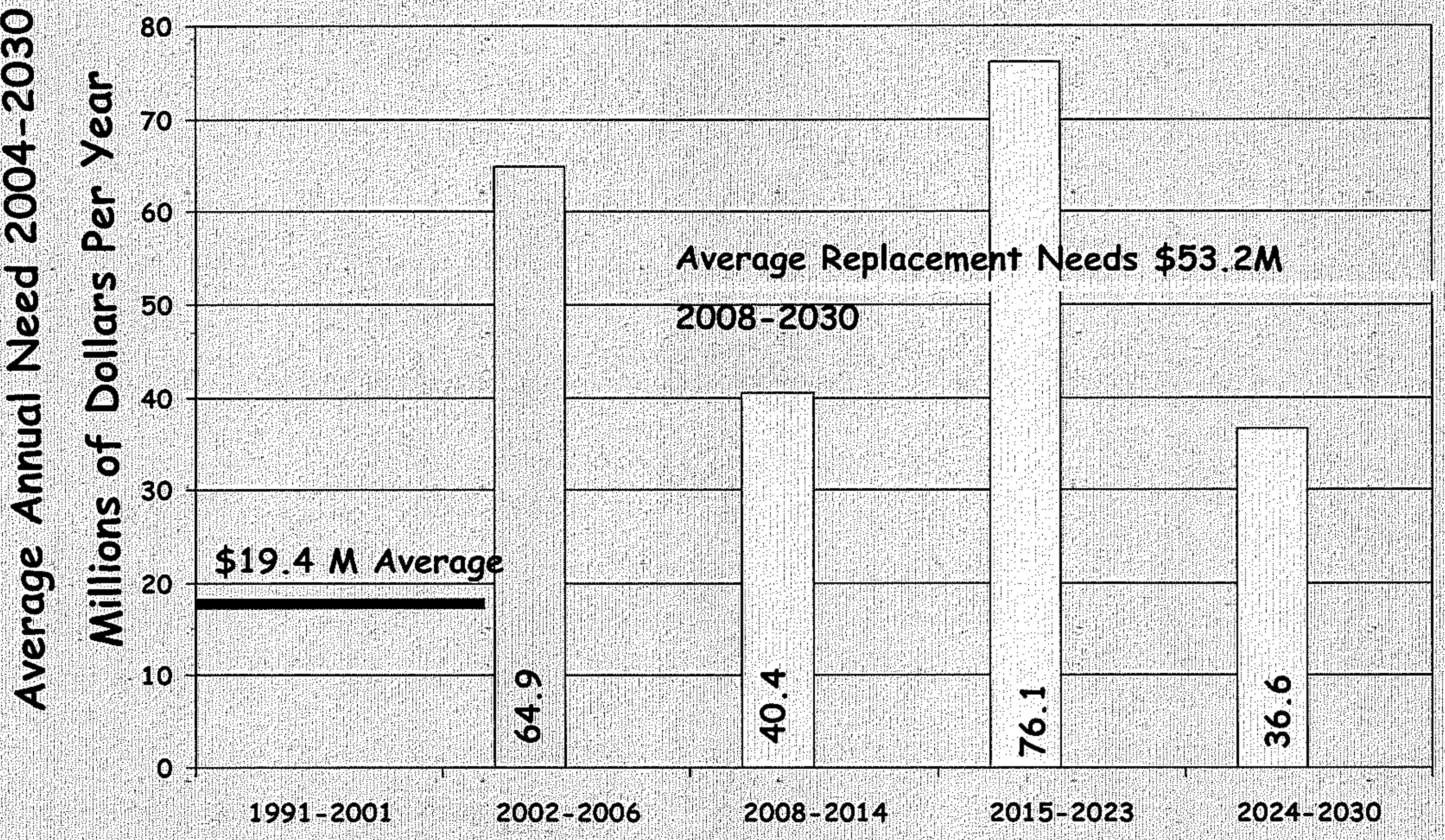
- Future Measure to Likely Focus on "Fair" and "Poor" With Goal of Maintaining Current Level
- "Fair and "Poor" Bridges Reflect Contract Repair and Replacement Needs i.e. Significant Investment
- Condition Trend of Declining "Good" Bridges Predicts Eventual Increase in "Fair" and "Poor".
- With Preventative Maintenance, "Good" and "Satisfactory" Conditions Can be Prolonged
- In 2004, Bridge Management System Forecasting Model Will be Enhanced

Future Trends in Condition and Investment Needs

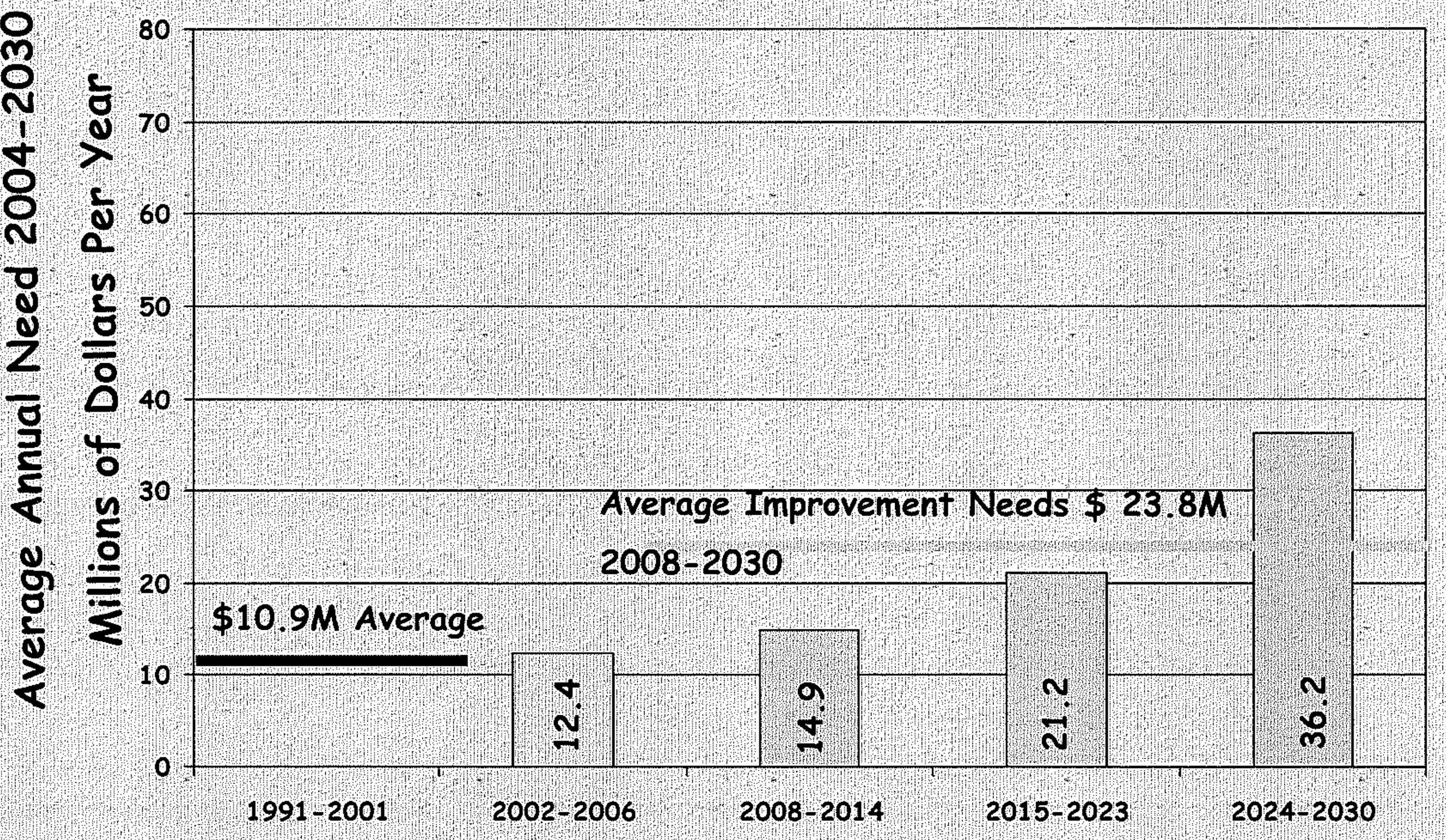
AGE PROFILE BY AREA OF STRUCTURES
TRUNK HIGHWAYS ONLY
STRUCTURES 10 FT AND OVER
2003



Statewide
Bridge Replacement



Statewide
Bridge Improvement



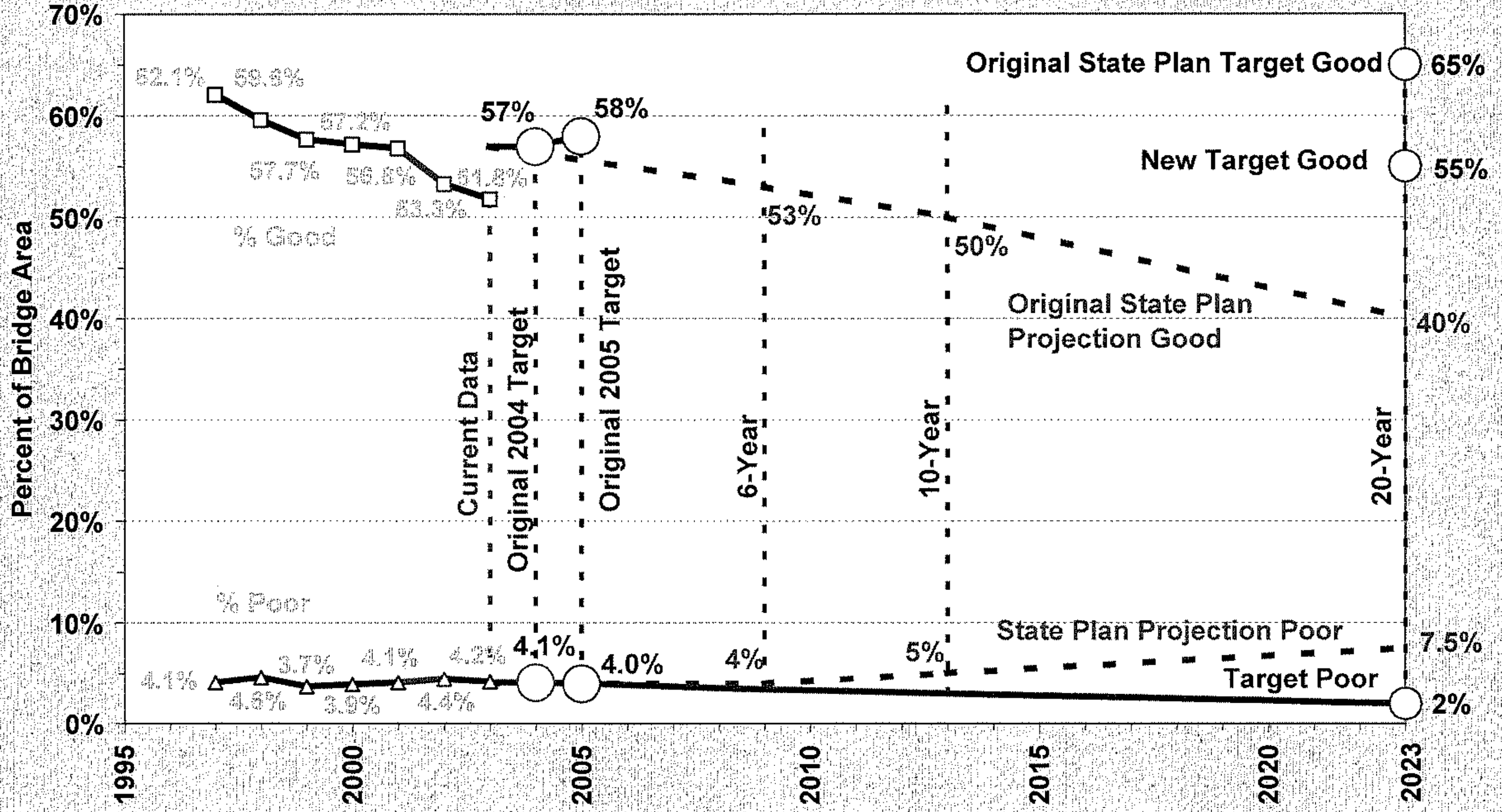
Increased Bridge Needs
2007-2030

Projected	**Compared to Past 15 Years**
■ Bridge Replacements $53 Million/ year	■ 158%
■ Bridge Decks 14.8 Million/ year	■ 190%
■ Bridge Painting 9.0 Million/ year	■ 260%
Total estimate 77+ Million/ year	■ 173%

Prepared for the Statewide Transportation Plan

Structural Condition of Bridges

Principal Arterials



Revised 12-22-03

Source: Mn/DOT Office of Bridges

"Budget Buster"
Major TH Bridges Requiring Replacement or Renovation in the Next 10 Years

D7	TH 169/Minnesota at Le Sueur	2005
Metro	TH 36/St Croix at Stillwater	2007
D2	TH 11/Red River at Robbin	2008
Metro	TH 52/Mississippi in St Paul - Lafayette	2010
D6	I90/Mississippi at Dresbach	2010
Metro	I 35E/Cayuga St & RR in St Paul	2010
Metro	I35W/Mississippi in Minneapolis	2012
Metro	TH 61/Mississippi at Hastings	2014

"Budget Buster" Bridge Challenge

- Fracture Critical Issues and/or Deterioration Will Require Replacement/Renovation
- Districts Wills be Unable to Fund Major Bridges From Their Annual Investment Target
- Bridge Cost Alone Can be Over 1/3 of Annual Funds
- Additional Funding Sources Will Be Needed Such as High Priority Federal, District "C" Setasides, Legislative Action
- These Bridges Have Been Included in 2004 High Priority Congressional Request List

Statewide Preventative Maintenance Needs

- Current Maintenance Program is Largely Reactive, Less Focused on Preventative Maintenance:
  - Preventative Maintenance = Flushing Joints and Decks, Spot Painting, Sealing Cracks
  - $1.3 Million per year
  - 89 Bridge Workers Statewide
- District Operations Planning Process (HSOP) will Identify:
  - Cost effective PM strategies
  - Performance Measures and Targets and Gaps
  - Funding needed to meet targets,
  - Performance under constrained funding

Statewide Investment in Bridges

Average 1997-2003

Average Spending/Year		**Part of each Bridge $1 Spent**
Bridge Replacements $34,123,000	=	72 cents
Bridge Improvement $11,625,000	=	25 cents
Staff Preventative Maintenance $1,317,000	=	3 cents
TOTAL	=	**$1.00**

Report for Commissioner's Staff Meeting

Summary

- Overall Bridge Condition Will Continue to Decline Without Increased Investment
- Goal to Maintain the number of Fair and Poor Bridges at about 13%
- To Maintain Current Level of Fair and Poor Bridges, Funding Levels Need to Nearly Double in 2008-2023
- To Maintain Bridges in Good and Satisfactory Condition, We Need to Increase Preventative Maintenance Efforts
- Districts Will Need Additional Funding Sources for "Budget Buster" Bridges

Mn/DOT & Local Bridges Compared to United States

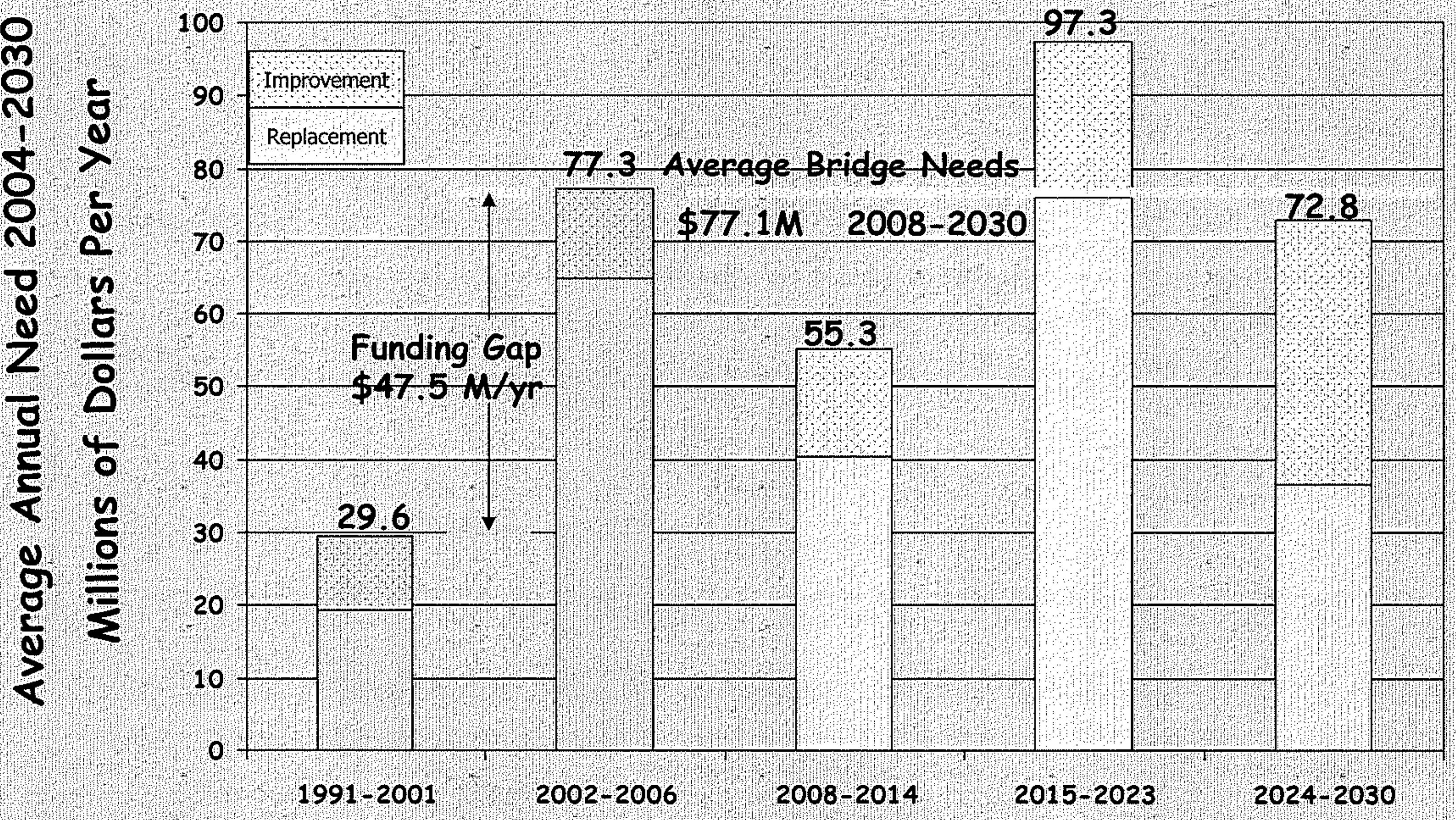
Percentage of Bridges Structurally or Functionally Deficient ("Poor" Condition) from Better Roads Magazine

November 2003

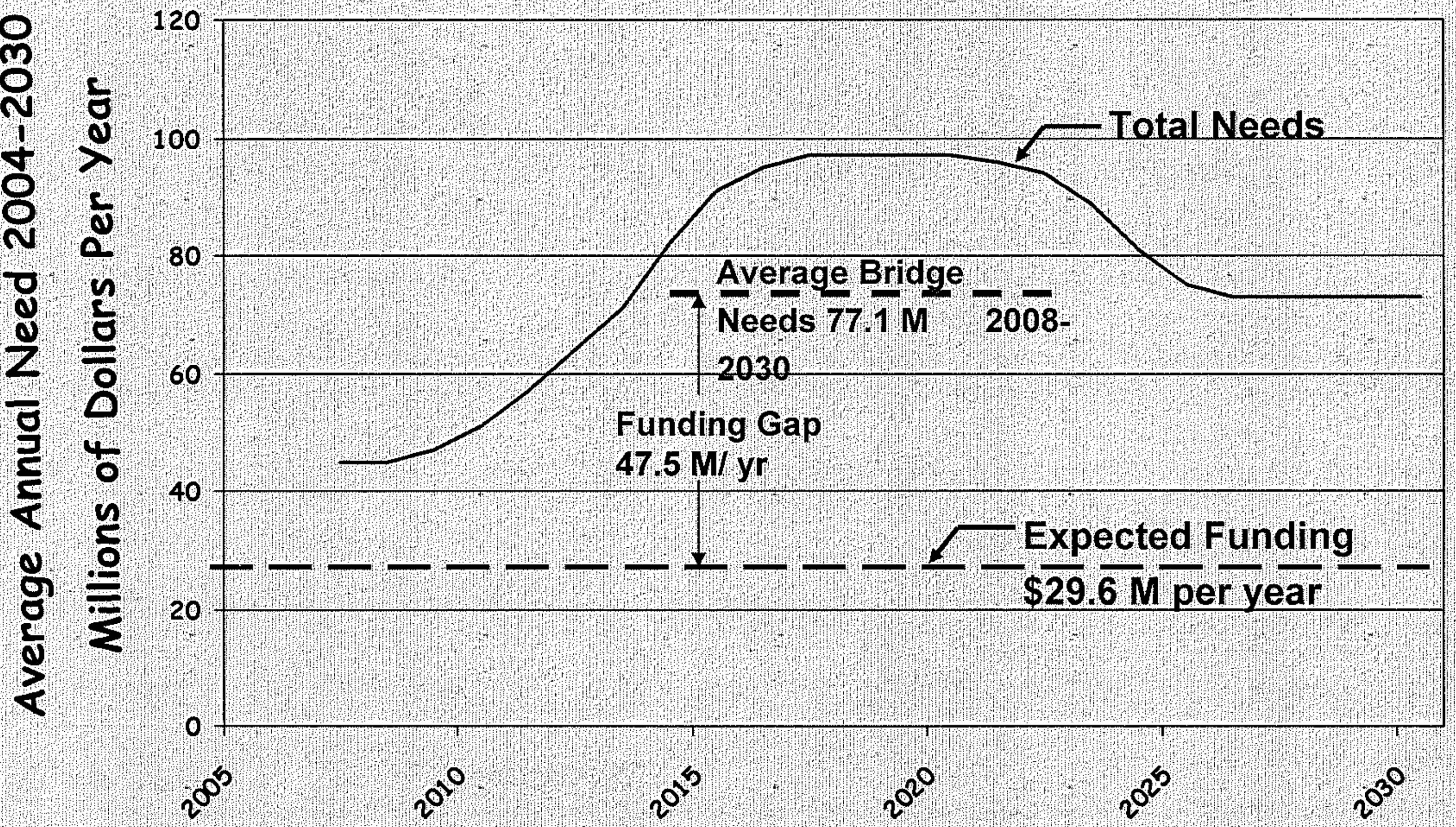
	Minnesota	US
State Bridges	10	22
County/City/Township	16	29
Overall	15	26

While Minnesota Bridges Are In Better Condition Than the National Average, US Bridges Overall Are In Poor Condition.

Statewide Bridge Replacement And Improvement



Statewide
Bridge Replacement



Report for Commissioner's Staff Meeting

February 8, 2005

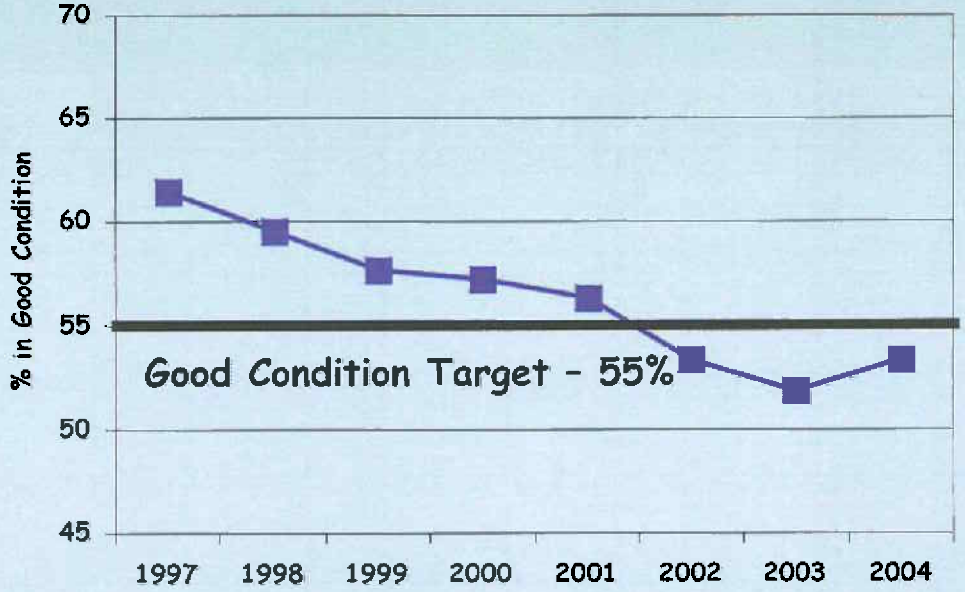
- Current Bridge Structural Condition and Trends
- 20 Year Plan Bridge Preservation Investments and Condition
- HSOP (Highway System Operations Plan) Summary of Recommendations
- Major Bridge Projects in the Next Decade

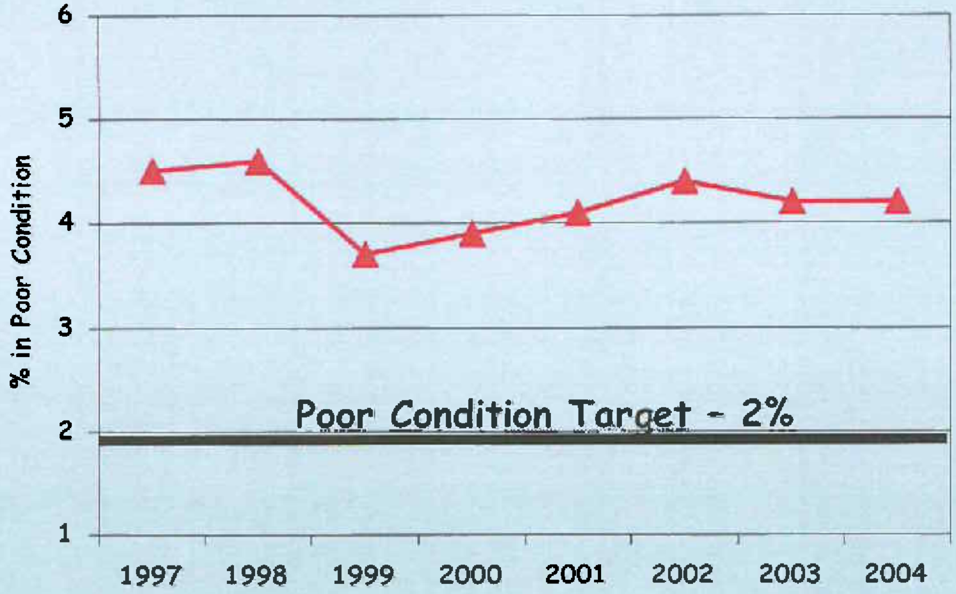
2004 Performance Summary for Bridge Structural Condition

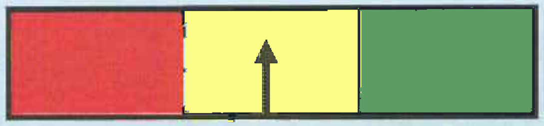
- Statewide average bridges in "Good" structural condition improved by 1.5% to 53.3%, which is encouraging after 6 Years of decline. Reflects increased investments since 2002.
- Statewide average of "Poor" bridges remained the same at 4.2%, indicating preservation investments are just matching deterioration rates.
- With Recommended 20-Year Plan and HSOP Investments, Mn/DOT can maintain overall statewide bridge condition measures
- However, major Fracture Critical Bridge Projects continue to be postponed due to funding

STATEWIDE

Trunk Highway <u>Principal Arterial Bridges</u> (20′ and Over) Structural Condition Performance Target (Percentage by Area)



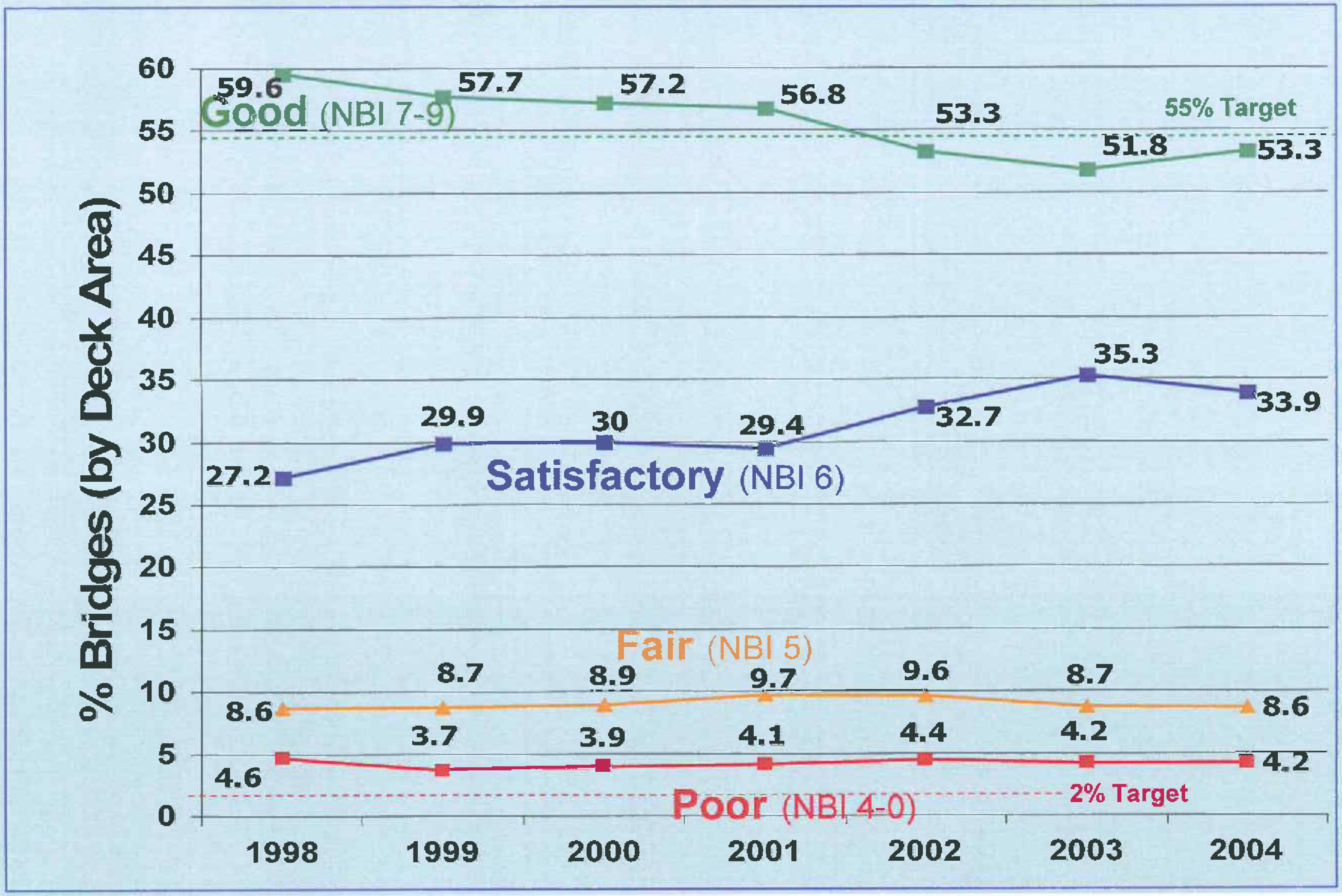




Principal Arterial = 84%
of TH Bridge Area

January 2005

STATEWIDE BRIDGE CONDITION
TRUNK HIGHWAY PRINCIPAL ARTERIAL
20 FT AND OVER

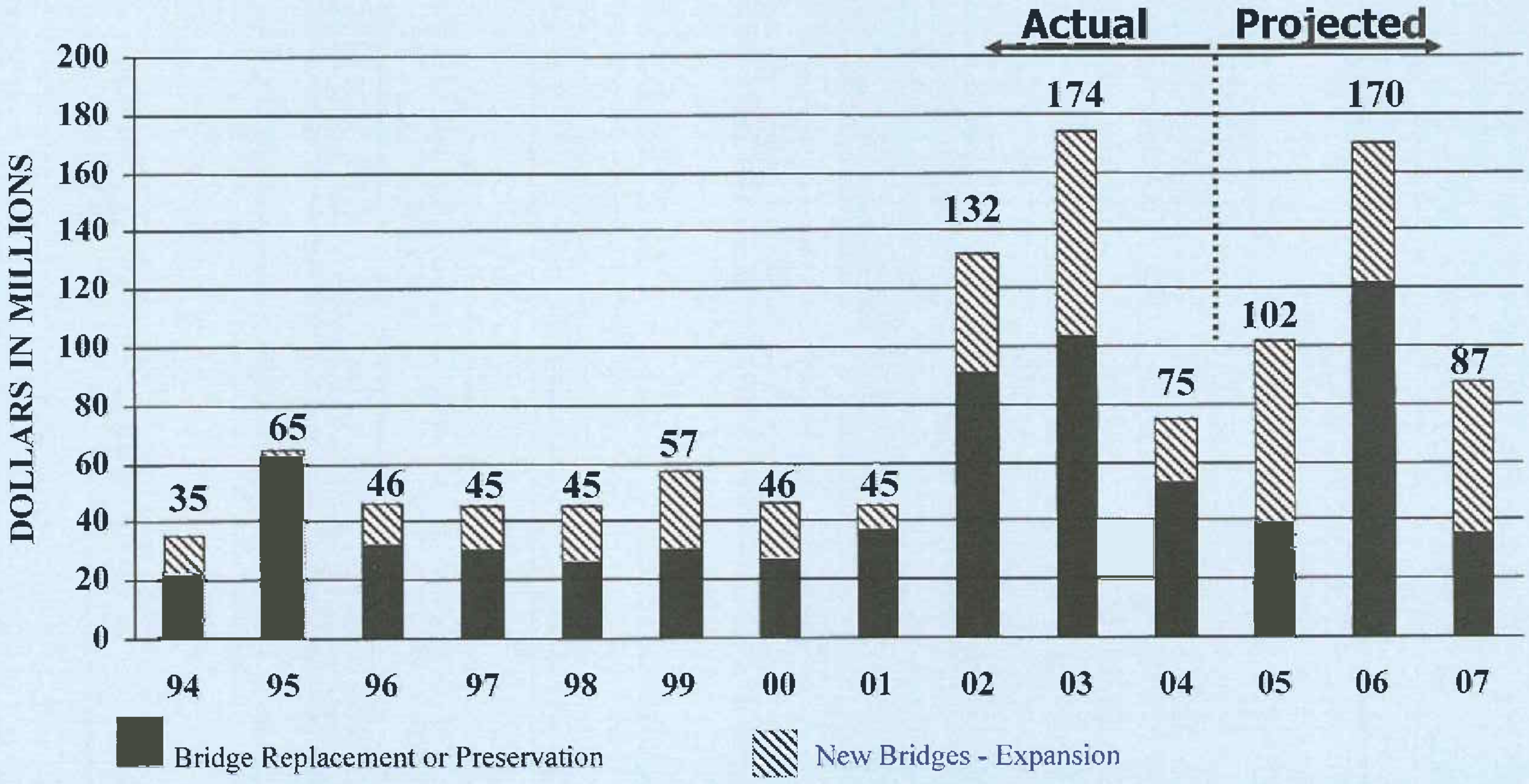


MN/DOT BRIDGE CONSTRUCTION

Let or Programmed

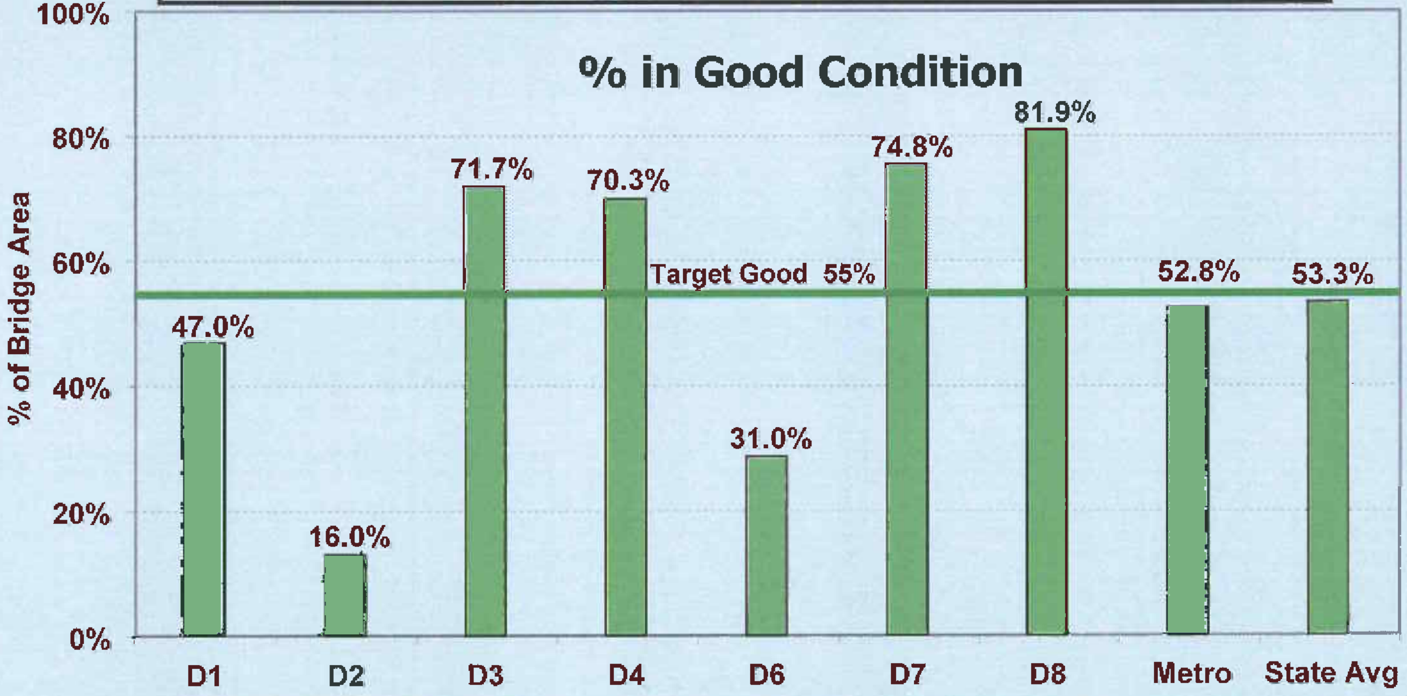
Includes Expansion, Replacement, Preservation, Design Build and Culverts

December 2004



Above dollars represents bridge portion of project costs.

Bridge Structural Condition - Principal Arterials – 2004



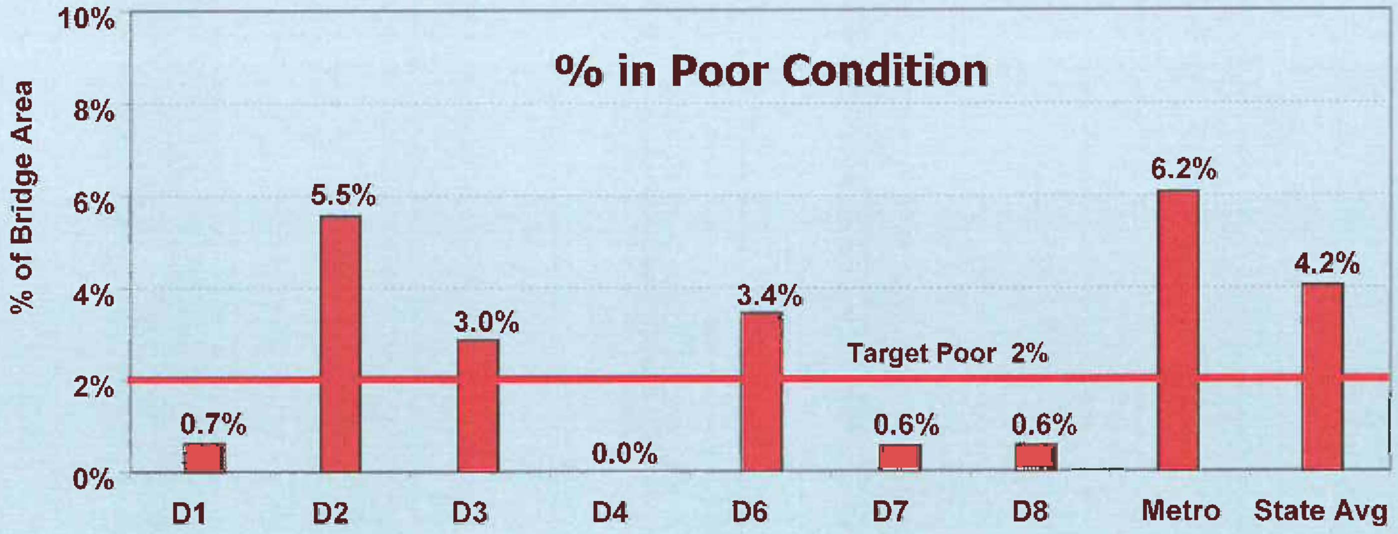
Improved in 2004:

Districts 2, 3, 4, 6, 8, and Metro

Declined in 2004:

Districts 1 and 7

Districts 4, 7, and 8 met both "Good" and "Poor" Targets



Improved in 2004:

Districts 2, 6, 8, and Metro

Declined in 2004:

Districts 1 and 3

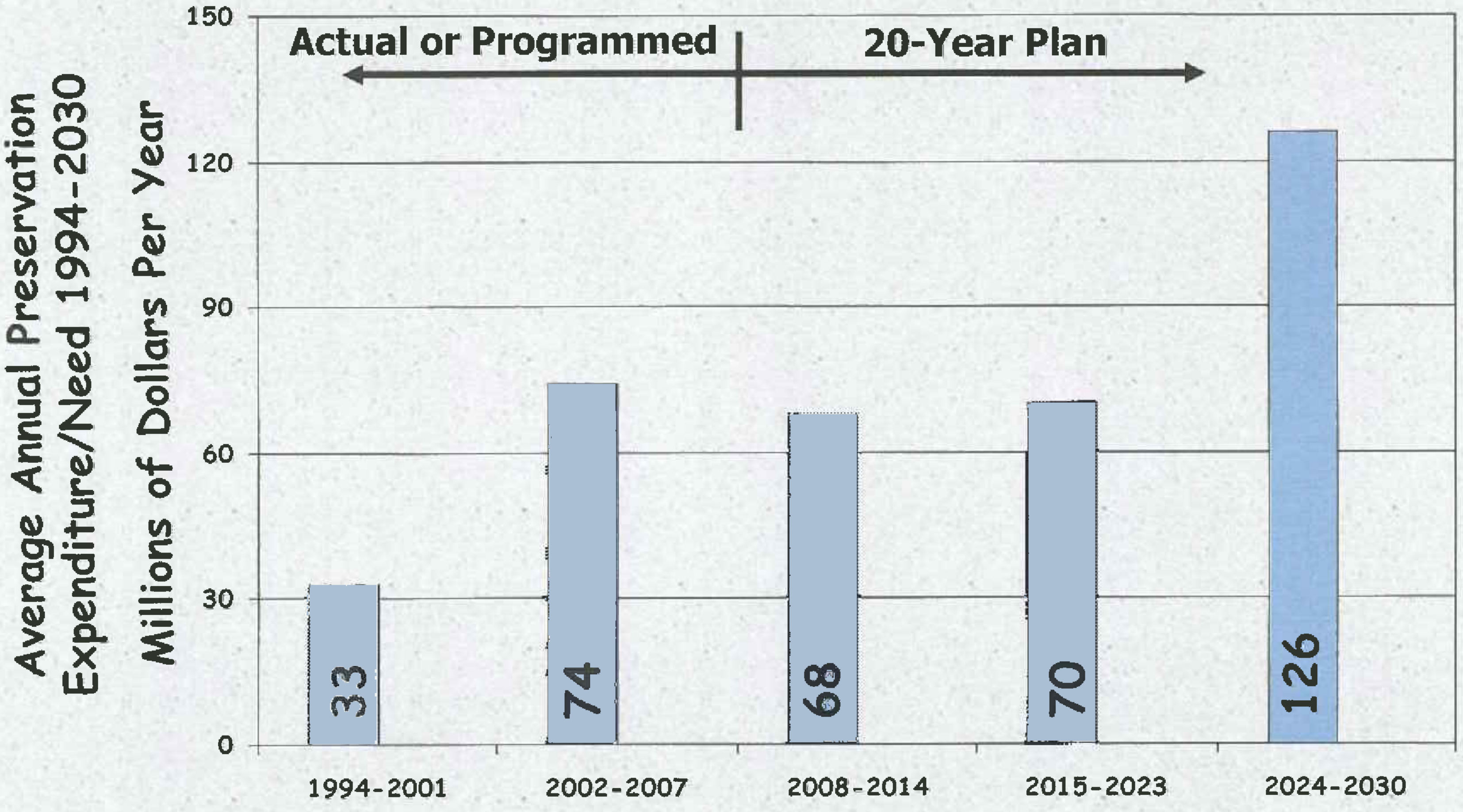
Unchanged in 2004:

Districts 4 and 7

Future Bridge Preservation Investments

- District 20-Year Plan (2008-2030)
- HSOP (Highway System Preservation Plan)

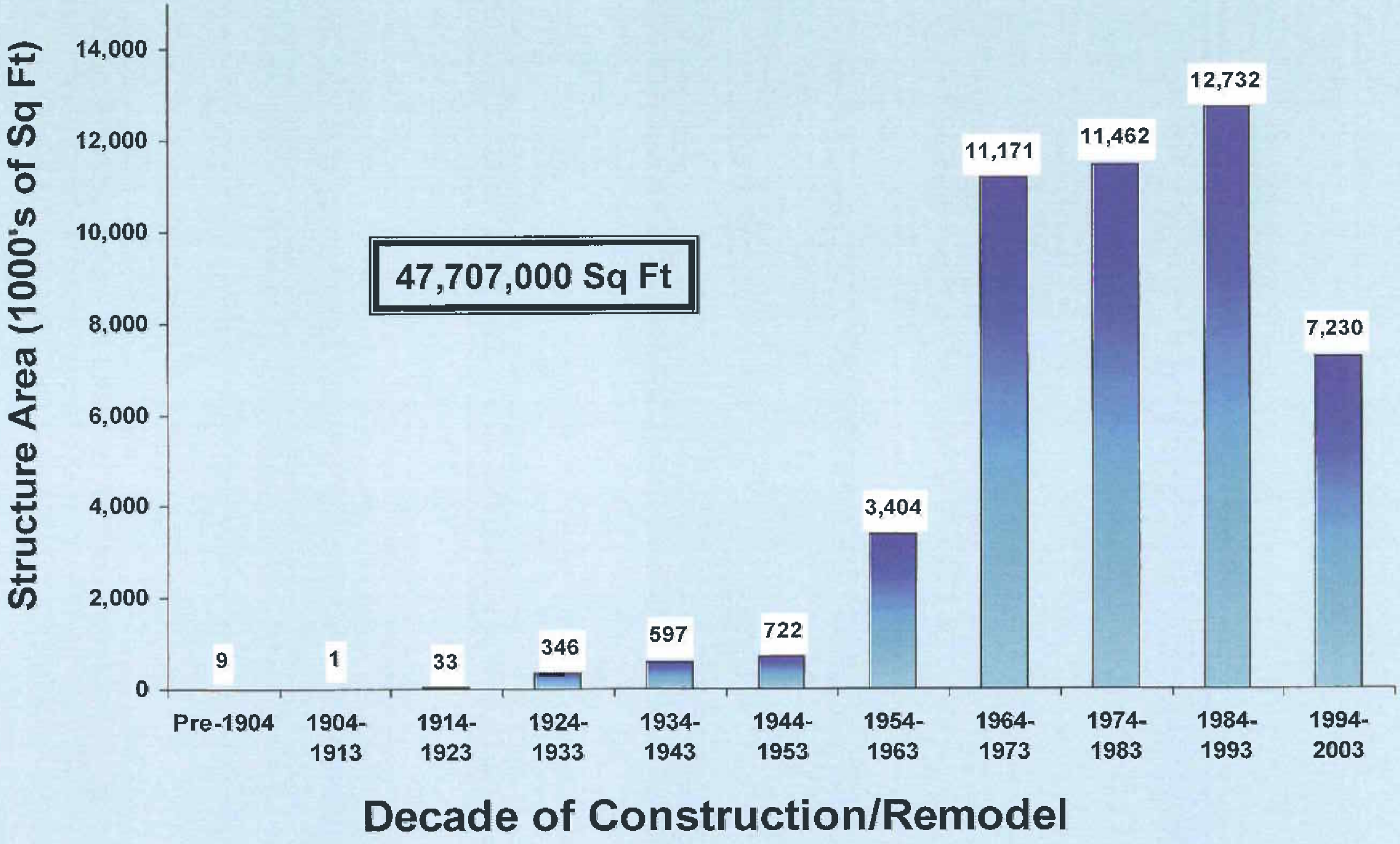
STATEWIDE
Annual TH Bridge Preservation Expenditures and Projected Needs



Preservation Includes Replacement, Renovation and Repair

AGE PROFILE BY AREA OF STRUCTURES TRUNK HIGHWAYS ONLY STRUCTURES 10 FT AND OVER

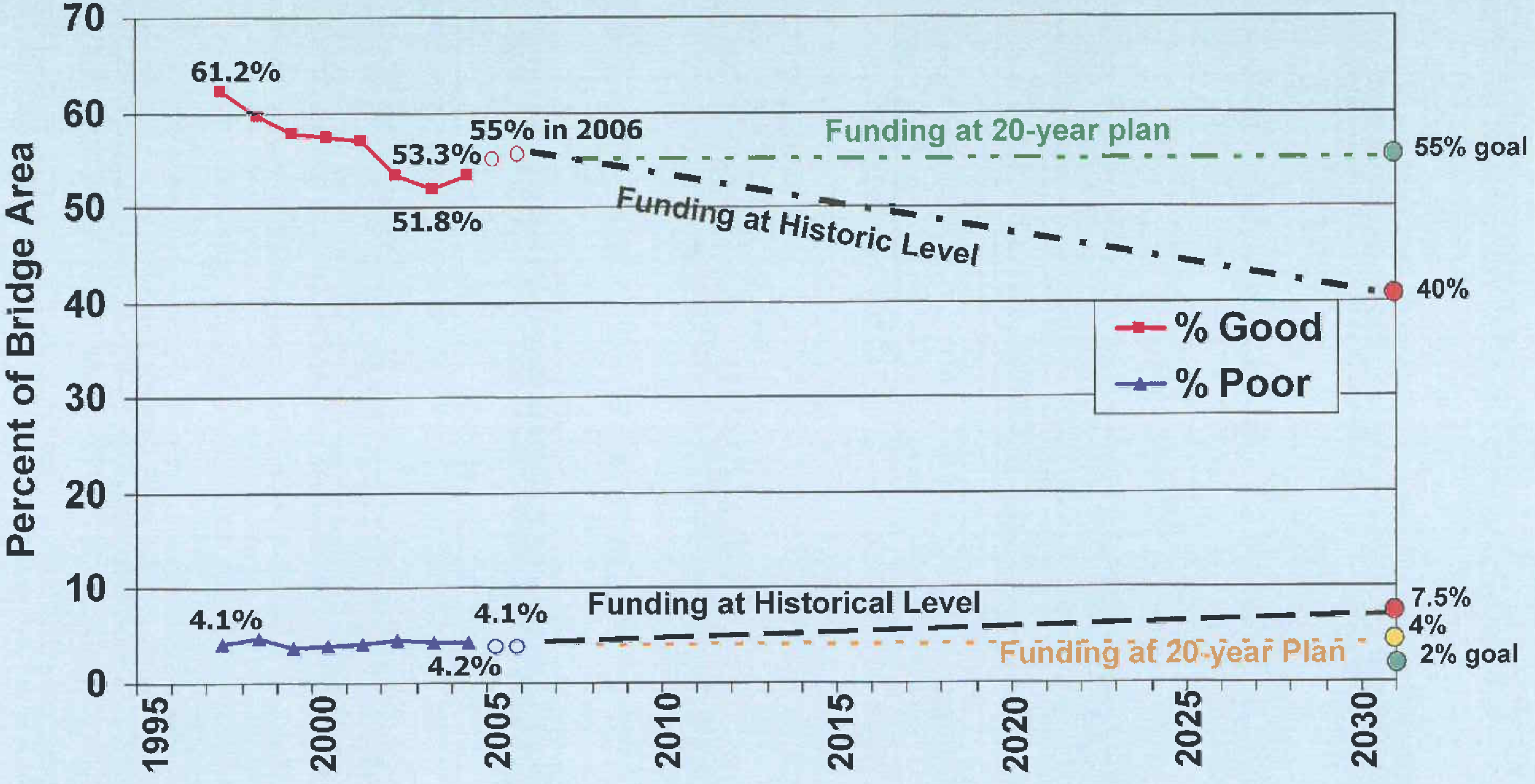
2004



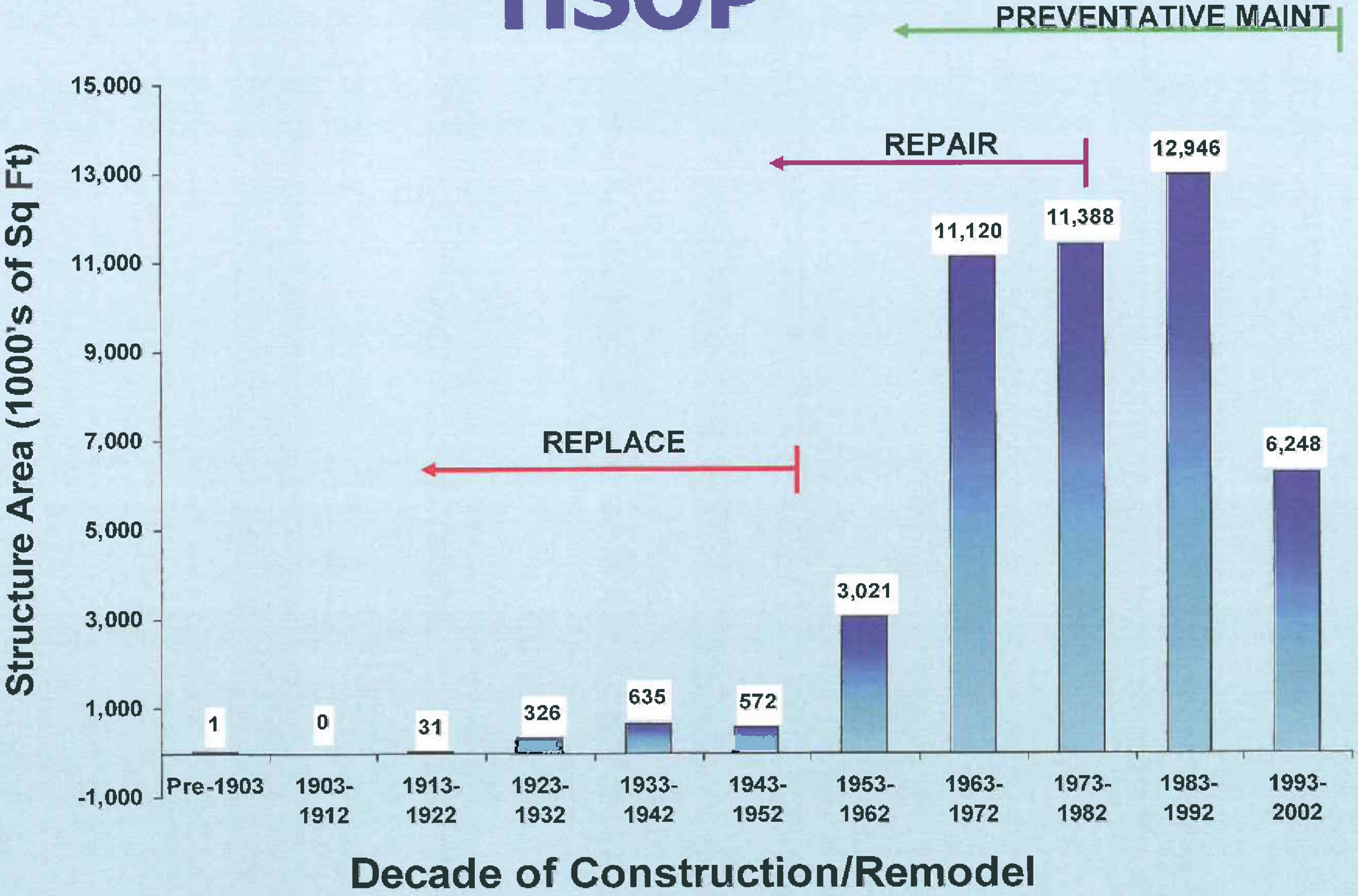
Prepared for the Statewide Transportation Plan

Structural Condition of Bridges

Principal Arterials



HSOP


PREVENTATIVE MAINT
REPAIR
REPLACE
Structure Area (1000's of Sq Ft)
15,000
13,000
11,000
9,000
7,000
5,000
3,000
1,000
-1,000
1
0
31
326
635
572
3,021
11,120
11,388
12,946
6,248
Pre-1903
1903-1912
1913-1922
1923-1932
1933-1942
1943-1952
1953-1962
1963-1972
1973-1982
1983-1992
1993-2002
Decade of Construction/Remodel

HSOP Bridge Preventative Maintenance Activities

Joint Seal Repair or Replacement

Deck Crack Sealing

Deck and Rail Surface Sealing

Flushing Salt Residue and Debris

Spot Paint Steel Beams

Seal Ends of Prestress Beams

Seal Bridge Seats

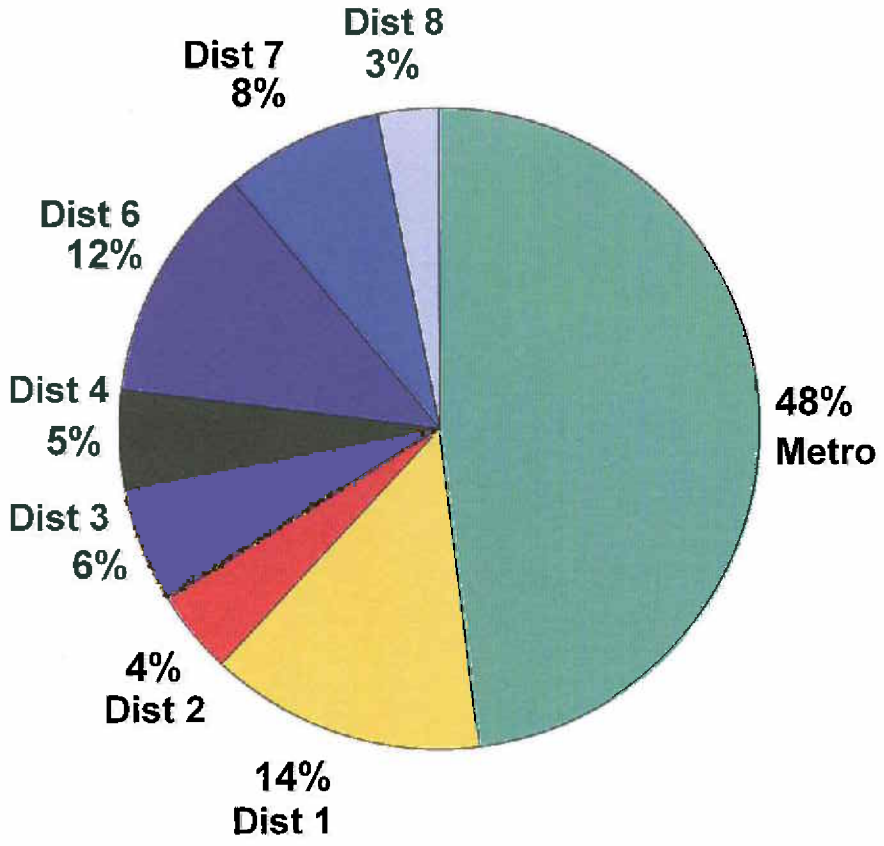
$1 preventative maintenance activities will save $4 in bridge repair and replacement dollars over the life of the bridge.

HSOP Bridge Annual PM Needs

$ 935,000	Joints
$2,367,000	Sealing
$1,386,000	Flushing
$4,688,000	Annual Total

About 10 cents / SF

Or about 0.1% of replacement value per year.



Mn/DOT Currently Invests $1,300,000 in Bridge Preventative Maintenance

"Budget Buster"

Major TH Bridges Requiring Replacement or Renovation in the Next 10 Years

		Construction Letting Needed	Work Plan/ Funding FY
D7	TH 169/Minnesota at Le Sueur	2007	2007
Metro	TH 36/St Croix at Stillwater	Immediate**	Beyond 2014
D2	TH 11/Red River at Robbin	2008*	2008
Metro	TH 52/Mississippi in St Paul - Lafayette	2010**	2011
D6	I90/Mississippi at Dresbach	2010**	2013
Metro	I 35E/Cayuga St & RR in St Paul	2010	2014
Metro	I35W/Mississippi in Minneapolis	2015*	Beyond 2014
Metro	TH 61/Mississippi at Hastings	2015**	Beyond 2014

*Fracture Critical

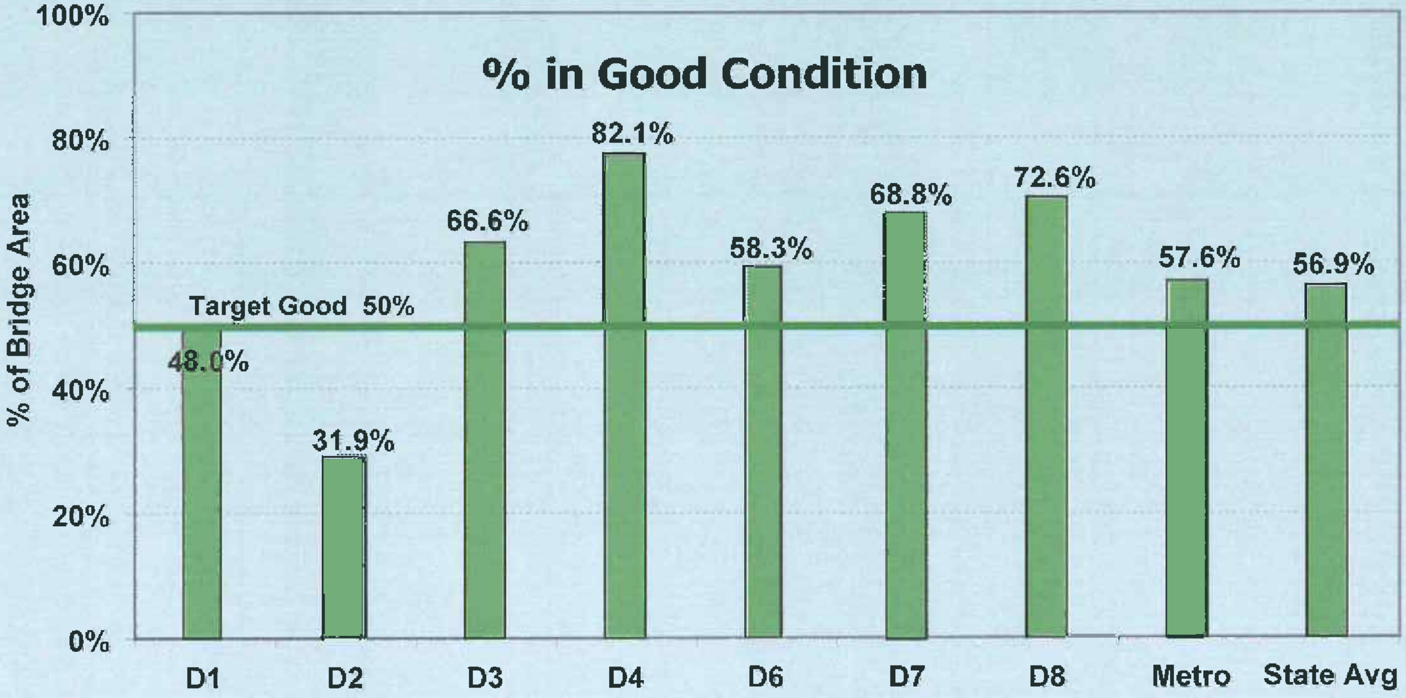
**Fracture Critical and Have Required Significant Repairs to Remain in Service

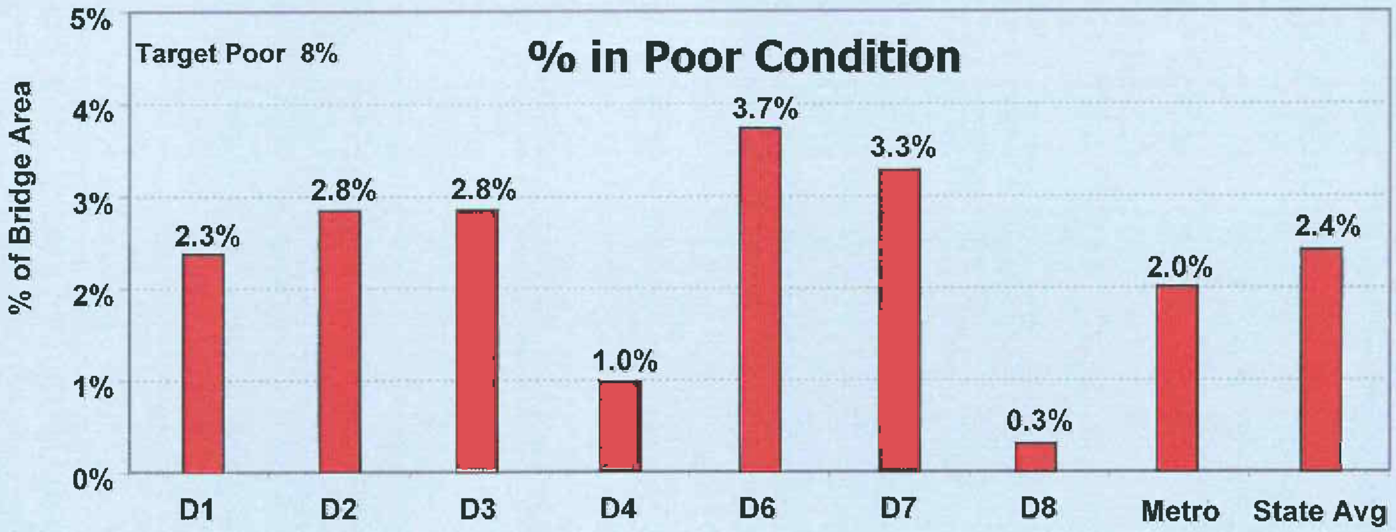
2005 Report for Commissioner's Staff Meeting

Summary

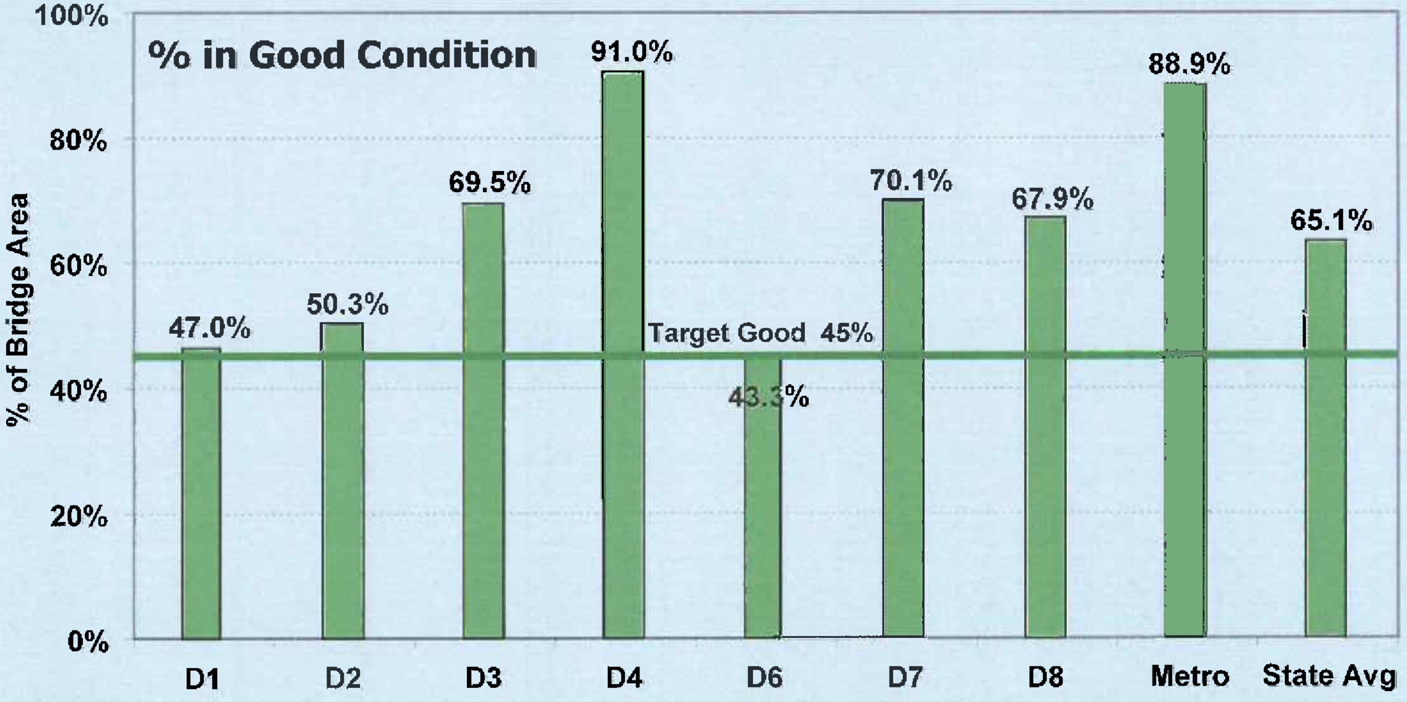
- Improvement in "Good" Condition Trend is Encouraging After 6 Years of Decline
- To Maintain Current Level of "Fair" and "Poor" Bridges, Implementation of District 20-Year Plan Preservation Projects is Necessary
- Implementation of HSOP Bridge Preventative Maintenance is Necessary to Extend the Time Bridges Remain in "Good", "Satisfactory", and "Fair" Condition
- With Recommended 20-Year Plan and HSOP Investments, Mn/DOT Can Maintain Overall Statewide Bridge Condition Measures
- However, Major Bridges that are Fracture Critical Continue to be Postponed Due to Funding

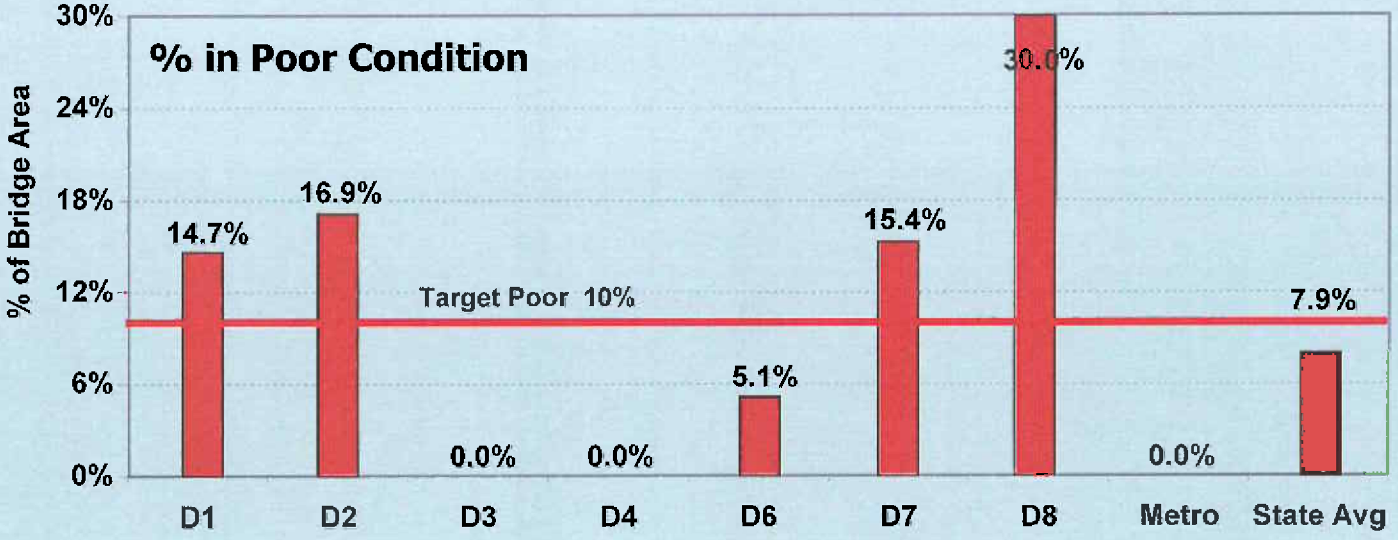
Bridge Structural Condition - Minor Arterials - 2004





Bridge Structural Condition – Collector/Local - 2004





WJE | ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062
847.272.7400 tel | 847.291.9371 fax
www.wje.com

Via Email: daniel.dorgan@dot.state.mn.us

March 31, 2008

Mr. Dan Dorgan
Chief Bridge Engineer
Minnesota Department of Transportation
3485 Hadley Ave. N.
Oakdale, MN

Re: DeSoto Bridge Gusset Plate Evaluation
WJE No. 2008.1472

Dear Mr. Dorgan:

At your request, we performed an evaluation of selected gusset plates on the main trusses of the DeSoto Bridge located in St. Cloud, Minnesota. Our findings are summarized in this letter.

BACKGROUND

On March 21, 2008, you contacted WJE and asked that we evaluate the condition of certain gusset plates on the DeSoto Bridge, located in St. Cloud, Minnesota. On March 23, 2008, we reviewed the following documents that were provided by your office:

- Original Sverdrup design drawings
- Original Illinois Steel Bridge shop drawings
- 1978 deck repair and overlay plans
- Various inspection reports

On March 24, 2008, we met with you and other MnDOT representatives in your Oakdale office to review MnDOT calculations and inspection findings related to gusset plates at main truss nodes U6 and L11. During this meeting, you informed us that the U6 and L11 gusset plates were going to be modified by adding stiffeners to all unsupported edges. On the following day, we examined gusset plates on the east main truss of the bridge, focusing on the L11 node.

Following our site inspection, we evaluated the U6 and L11 gusset plates, taking into consideration current conditions, current dead load, and original HS20 and pedestrian live loads. We have also reviewed plate edge stiffening details that were provided by your office after our visit.

SITE OBSERVATIONS

Using a snooper, we performed a close-up visual examination of the L11 gusset plates on the east main truss. This location was selected because, according to previous MnDOT inspections, it exhibited the most severe distortions sustained by any of the L11 and U6 gusset plates. During our inspection, minor visible distortions were noted. In our opinion, the noted distortions are related to original fit up issues (e.g. imperfect match of member depths, slight misalignment of members, or typical erection stresses). It is also our opinion that the observed distortions have not compromised the abilities of the affected gusset plates to sustain required design loads. No signs of significant distress (e.g. load effects) or deterioration were noted.

STRUCTURAL EVALUATION

Structural evaluations of the U6 and L11 gusset plates were performed based on loads from the original design drawings and additional deck loads estimated from the 1978 deck repair and overlay drawings. In all cases, calculated critical stresses were within original design limiting values. We also found that the plates were more than sufficient to sustain a current AASHTO Operating Rating of greater than one for the original traffic loading.

It is worth noting that a comparison of the DeSoto Bridge U6 and L11 gusset plates with the deficiently designed I35W Bridge U10 and L11 gusset plates indicates the following:

- The DeSoto gusset plates and the I35W gusset plates are similar in length and identical in thickness
- The DeSoto Bridge and I35W Bridge gusset plates were installed without free edge stiffeners that were required by the applicable design standards
- The DeSoto gusset plate design loads are approximately one half of the loads that were carried by the I35W gusset plates before the bridge collapsed

These observations are consistent with our findings that the DeSoto plates are adequately proportioned.

Since it is possible that the lack of code-specified free edge stiffeners could adversely affect the ultimate strengths of affected DeSoto Bridge gusset plates, your decision to install the required stiffeners appears prudent. The stiffening details provided by your office will bring the gusset plate free edges into full conformance with the original design specifications.

SUMMARY

Based on our evaluation of the U6 and L11 gusset plates on the DeSoto Bridge, it is our opinion that they have sufficient strength to carry current dead loads and original design traffic loads. It is also our opinion that proposed gusset plate stiffening details will bring the modified plates into full conformance with original design specifications.

We appreciate the opportunity to be of service to you and your department. Let us know if you have any questions about this report or if we can provide any additional assistance.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Howard J Hill

Howard J. Hill Ph.D.
Principal and Director of Technical Operations

Michael J. Koob

Michael J. Koob
Senior Principal

William J Nugent

William J. Nugent, PE
President and Registered Professional Engineer in Minnesota
License No. 41787

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am [illegible] Licensed Professional Engineer u[illegible] laws of the State of Minnesota.

Print Name: WILLIAM J. NUGENT
Signature: William J Nugent
Date 3/31/08 License # 41787

REL RICHLAND ENGINEERING LIMITED

29 North Park Street, Mansfield, Ohio 44902 • 419/524-0074 FAX 419/524-1812

96073

October 21, 1996

Mr. Neal Gresham
Acting District Twelve Deputy Director
Ohio Department of Transportation
5500 Transportation Blvd.
Garfield Heights, Ohio 44125-5396

Re: LAK-90-2342R over Grand River
Gusset Plate Failure

Gentlemen:

The failure of the truss gusset plates in the eastbound I-90 bridge over the Grand River is evaluated in the following discussion:

Introduction

On May 24, 1996 truss connections at joint L_8' at the east end of the eastbound structure failed in the north and south trusses. The gusset plates supporting the verticals and compression diagonals buckled and allowed the member ends to drop about 3 inches and move laterally about 3 inches. The damaged members were in the truss cantilever supporting the center suspended span. The bridge was closed to traffic.

Twin Bridges No. LAK-90-2342 L&R, each carry two lanes of Interstate Route 90 vehicular traffic over the Grand River about 30 miles east of Cleveland at mile post 209.7. The structures were built in 1960. End spans 1 and 5 consist of reinforced concrete deck on simple span, parallel steel girders. Spans 2, 3 and 4 consist of reinforced concrete deck on stringers and floorbeams, carried by two lines of arched cantilever deck trusses. The spans are about 75; 208; 297; 208; and 75 feet. Span 3 includes a 178 foot suspended span. The trusses are on chords of a 0°-28' horizontal curve.

Analysis

REL performed a literature search and identified methods to analyze gusset plates in truss connections. REL analyzed the full section L_8' gusset plates using approximate methods for buckling. The analysis identified weak areas in plate edge buckling between the lower chord (L_9' L_8') and the compression diagonal (U_9' L_8'); plate edge buckling between the vertical (U_8' L_8') and the tension diagonal (L_8' U_7'); and general buckling of the plate between the compression diagonal and the lower chord. These conservative analysis methods indicated the full section gusset plates were not adequate to support the design loads of the structure.

FHWA analyzed the full section L_8' gusset plates using finite element analysis methods. The FHWA analysis concluded "...the design thickness of the original gusset plate was marginal, at best, and its load carrying capacity was further exacerbated by loss of thickness due to corrosion." The analysis indicated the full design load on the truss members is just about equal to the load required to buckle the gusset plates, with no safety factor.

No analysis of the L_8' gusset plates has been performed using the actual deteriorated members.

Gusset Plate Condition

REL examined and measured the buckled gusset plates after they were removed from the bridge. The full thickness of the plates without section loss was 7/16 inch. A grid was marked on the plates, thickness measurements were made, and the information was used to develop a contour drawing of the thickness of each plate. Section loss was estimated along a line through the thinnest section in the buckled area of the plates. Most of the section loss was on the inside face of the gussets. The gusset plates were cleaned by abrasive blasting one or two days before the failure. At the time of the failure the L_8' gusset plate conditions were as follows:

- The north L_8' gusset plate of the north truss had about eight holes from deterioration in the center area around the compression diagonal and lower chord. The edges of the gusset plate were full thickness. The estimated section loss along the thinnest line was 35%.

- The south L_8' gusset plate of the north truss had one hole from deterioration in the area between the compression diagonal and lower chord. The estimated section loss along the thinnest line was 30%. The edges of the plate were full thickness.

- The north L_8' gusset plate of the south truss had no holes. The edges of the plate were full thickness. The estimated section loss along the thinnest line was 10%.

- The south L_8' gusset plate of the south truss had no holes. The estimated section loss along the thinnest line was 20%. The edges of the gusset plate had no section loss.

The north gusset plate on the north truss was noted by ODOT personnel to be bowed prior to the failure. The significance of the discovery was not realized until after the failure occurred.

The section loss in the gusset plates increased the actual stresses in the remaining materials. The capacity to resist buckling in the deteriorated plates was also reduced.

Applied Loads at Time of Failure

At the time of the failure a contractor was painting the structural steel of the bridge. The work began earlier in May and was progressing from the east end of the bridge toward the west end of the bridge. On the day of the failure the contractor had a line of trucks and equipment on the right shoulder of the bridge, the right lane was closed to traffic, and traffic was being maintained in the left lane. Based on observations and documentation furnished by ODOT personnel, REL estimated loads in the truss members at the time of the failure. An Ohio legal truck load was added in the left lane to simulate traffic.

The estimated loads at L_8' in proportion to the design loads are:

	North Truss	South Truss
Dead Load	77%	77%
Painter's Equipment	0%	15%
Legal Truck	9%	2%
Total	86%	94%

Although these are estimated applied loads, it appears they were approaching the full design load.

Non-Contributing Factors

Preliminary investigations raised questions about other factors contributing to the failure. Based on the analyses fatigue does not appear to be a factor in the failure of the gusset plates.

Temperature expansion of the bridge against closed and pack-rust frozen truss expansion joints does not appear to have contributed to the failure. Temperatures were rising on the morning of the failure which increased compressive forces in the upper and lower chords, but decreased forces in the truss vertical and diagonal members. This effect was measured with strain gages in the field and simulated with a locked expansion joint truss analysis.

Most of the bridge was wrapped in tarps to enclose the area being abrasive blasted and painted. Analysis of the enclosed structure found wind loads too small to contribute to the failure of the gusset plates. During the previous month, the maximum wind speed recorded at a nearby weather station was 37 mph, and only for a short period of time. The area that contributed wind load to the failure at L_8' was very small.

Conclusions and Observations

The sway bracing between the north truss and south truss verticals (L_8' U_8') makes up a structural system which includes the four L_8' gusset plates in the lower connection. The failure mode was sidesway buckling of the four gusset plates. The four gusset plates acting together provided the resistance to the applied loads. The four gusset plates failed at the same time because of the sway bracing connection. The combined section loss of the system of four gusset plates was estimated at 24%.

The gusset plates failed because the applied loads of the contractor's equipment and a legal truck load exceeded the actual capacity of the gusset plates. The deterioration of the gusset plates, particularly the north truss gusset plates, contributed to the failure. The westbound structure, with gusset plates in better condition, supported similar loading conditions during painting operations in the autumn of 1995. One similar L_8' gusset plate was noted to be bowed on the westbound bridge.

It is unknown if the buckling began at the full section edge of the gusset plates, or in the deteriorated center area of the gusset plates.

Repairs and Retrofit

All other gusset plates similar to L_8' in the twin bridges have been strengthened with the addition of stiffening angles bolted to the plates. The failed truss connections at joint L_8' of the eastbound structure have been lifted, realigned and reconstructed. Temporary supports were removed October 14, 1996.

The complete failure mechanisms and sequence can never be determined. Therefore all gusset plates in the bridge were analyzed by REL to evaluate the effects of design thickness, free edge buckling, and corrosion damage. All gussets determined by analysis to have less than 100% Ohio Legal Load capacity have been, or will soon be retrofitted by bolting stiffening angles to the plates. This work is being performed to insure that the bridges are safe and adequate for future use.

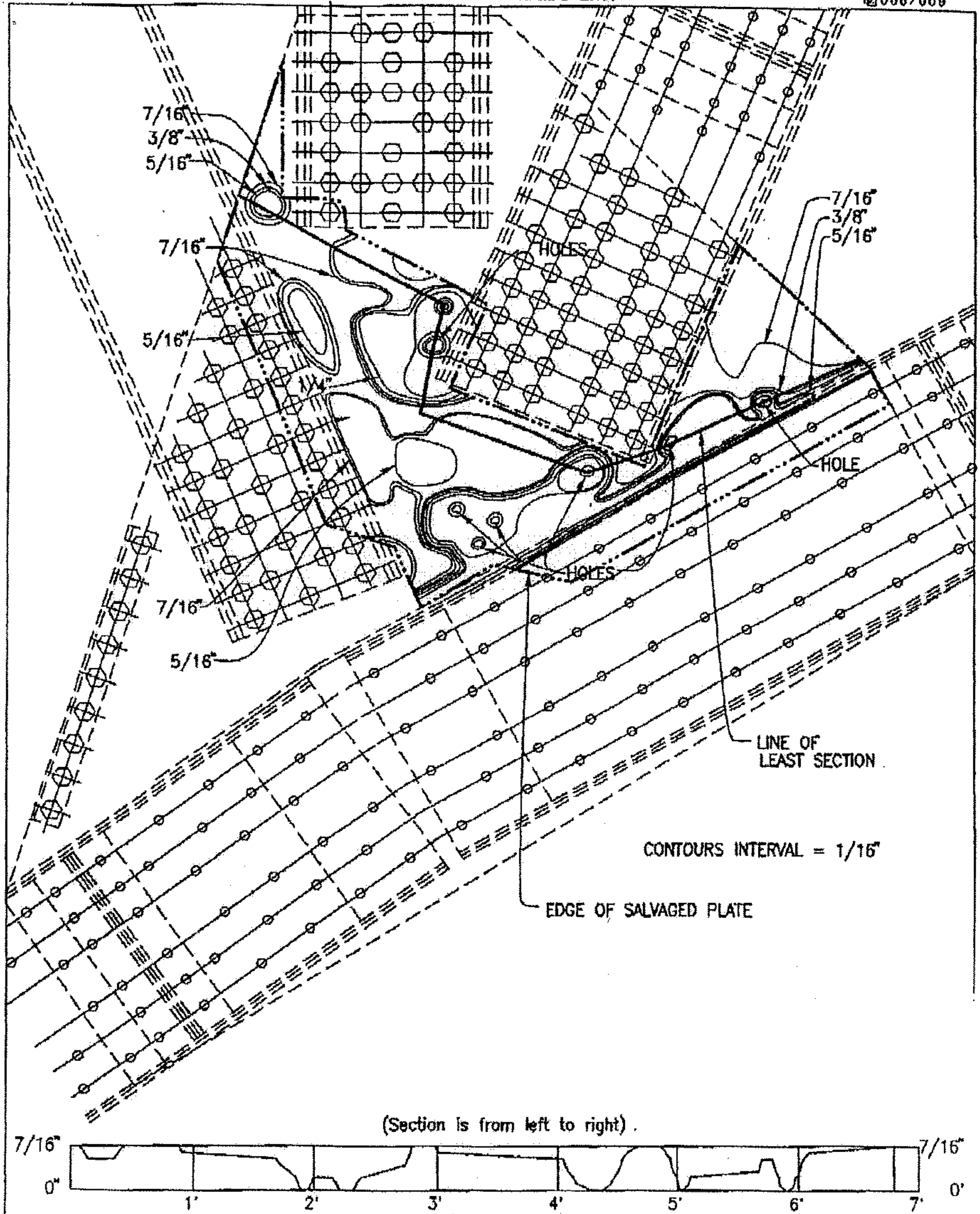
Very truly yours,

RICHLAND ENGINEERING LIMITED

Dean A Palmer

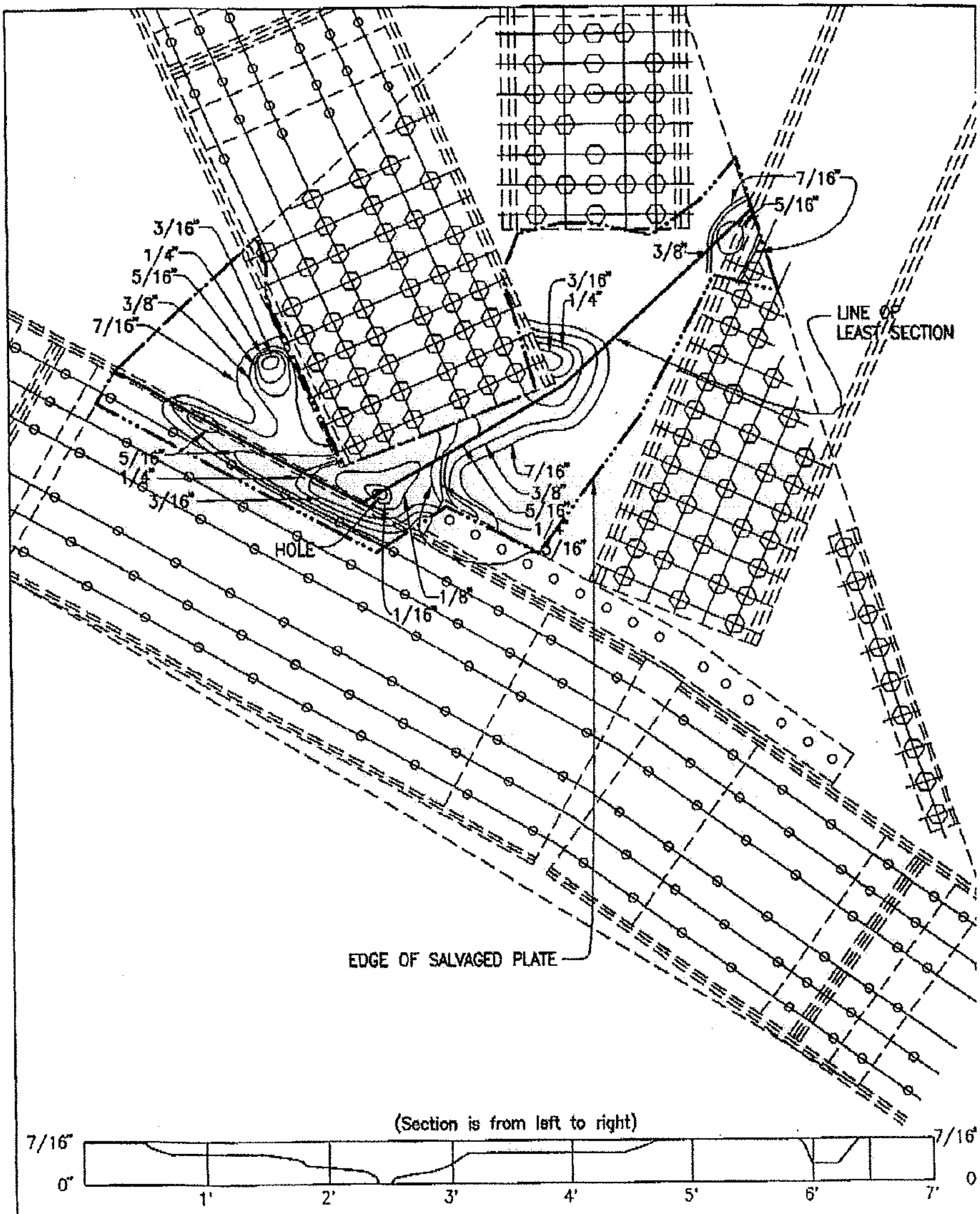
Dean A. Palmer, P.E.

DAP:sk
Enc.
cc: Mr. Chris Runyan
Mr. Brad Fragrell
Mr. Jim Barnhart
Mr. David Leake



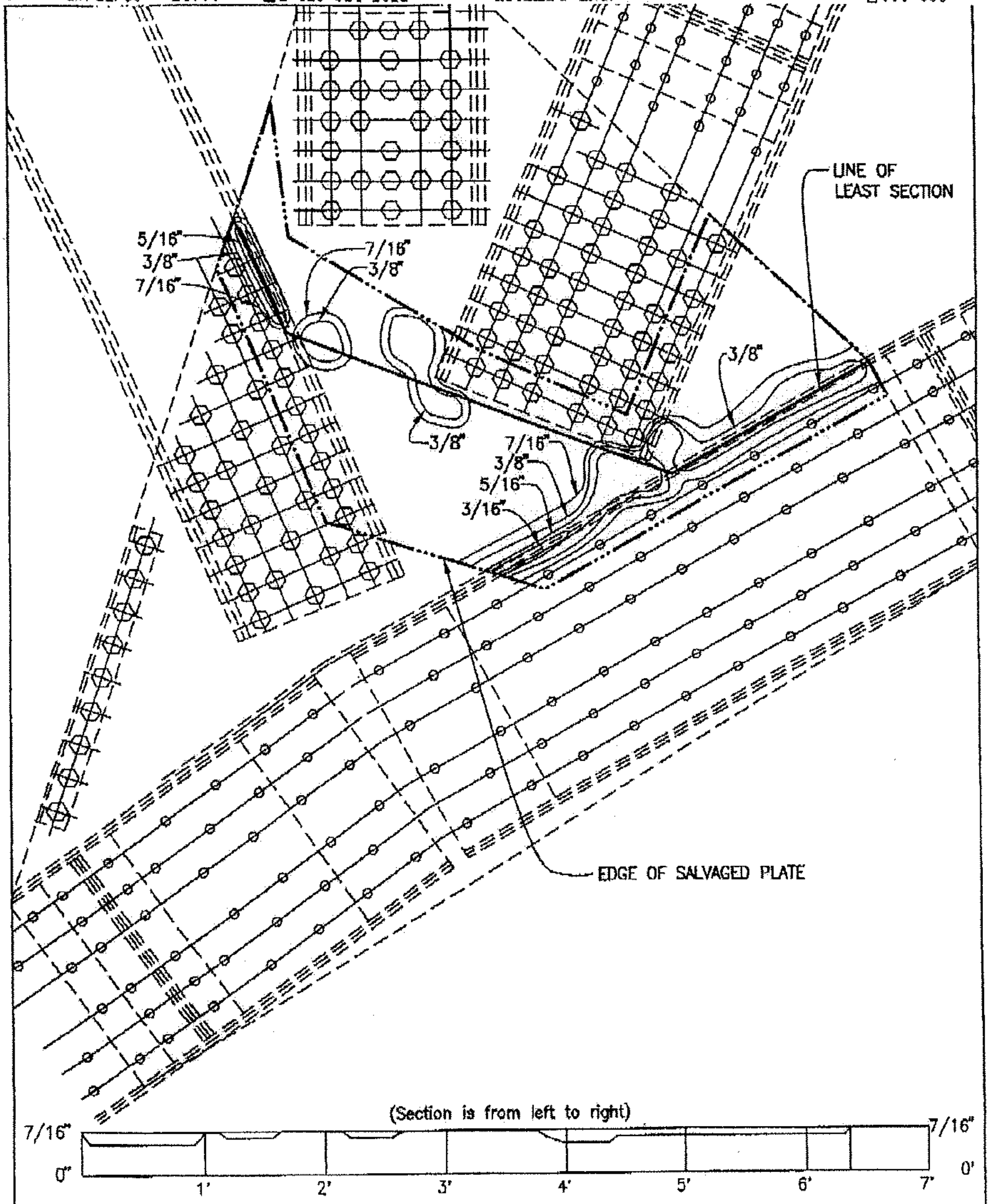
NORTH TRUSS EXTERIOR

36% Section loss along line of least section



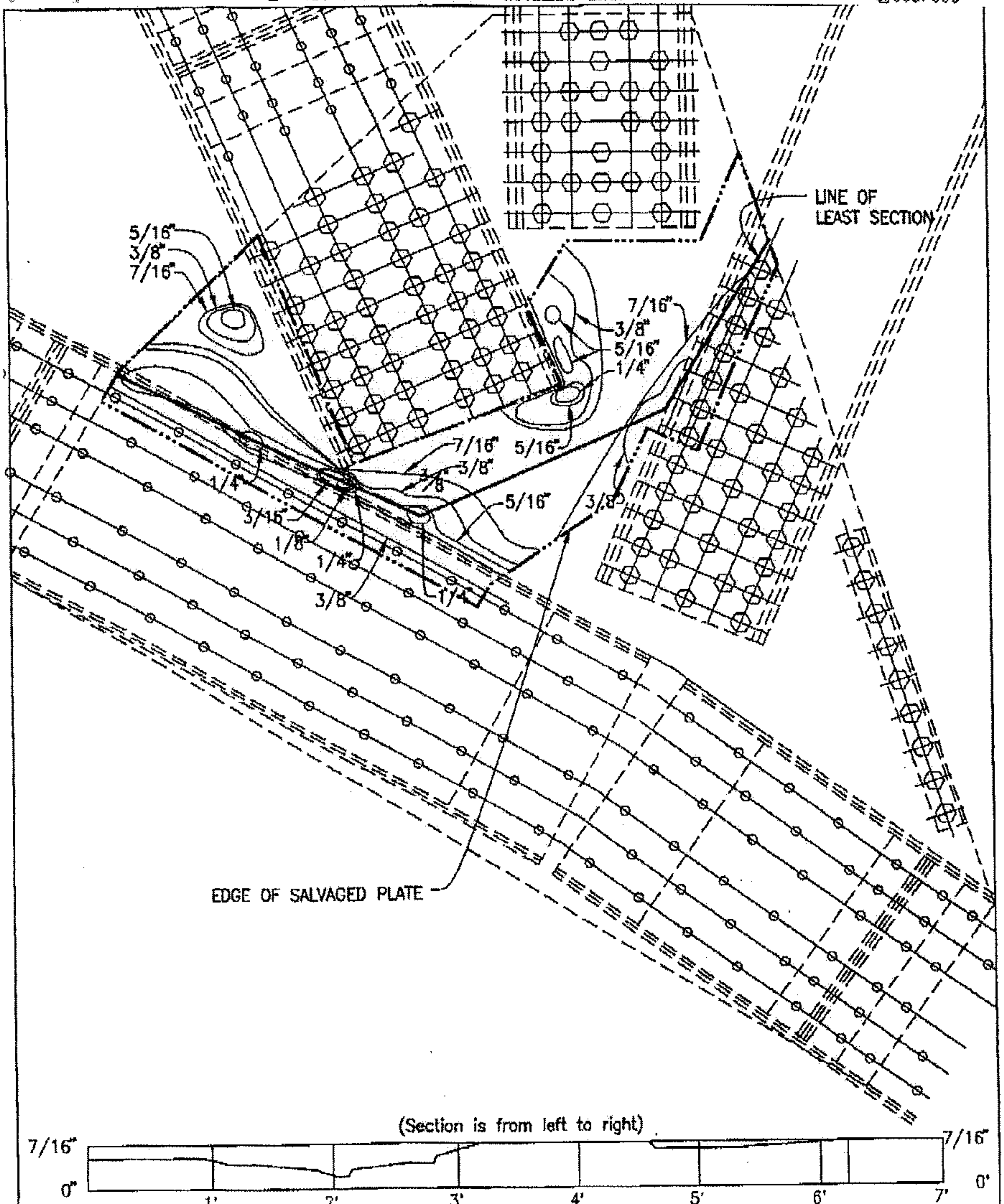
NORTH TRUSS INTERIOR

30% Section loss along line of least section



SOUTH TRUSS INTERIOR

13% Section loss along line of least section

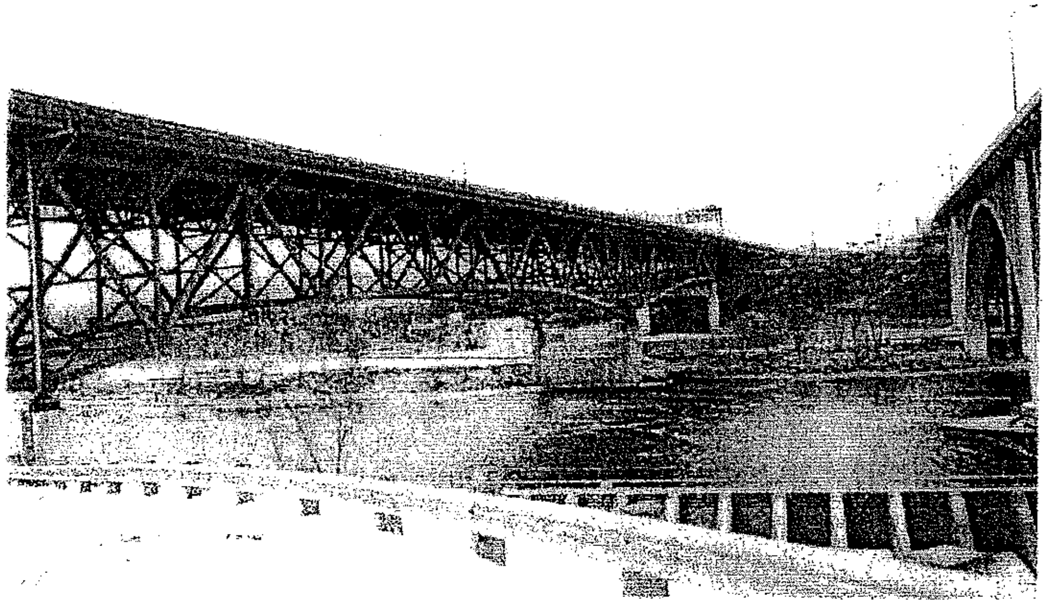


SOUTH TRUSS EXTERIOR

23% Section loss along line of least section

PROPOSAL FOR
STRUCTURAL EVALUATION OF BRIDGE NO. 9340
[I-35W OVER THE MISSISSIPPI RIVER]

HNTB OCTOBER 2001



ATTACHMENT A

PROPOSAL FOR REVIEW OF STRUCTURAL REDUNDANCY
MN/DOT BRIDGE NO. 9340 – I-35W OVER MISSISSIPPI RIVER

October 9, 2001

Mn/DOT has requested a proposal from the HNTB Corporation to evaluate the fatigue of various fracture critical members for Br. No. 9340 over the Mississippi River. This document represents HNTB's understanding of the terms and conditions that Mn/DOT and HNTB mutually concur to regarding the provided services under the pending Agreement. The document is organized as follows:

I. Project Background
II. Qualifications
III. Scope of Services
IV. Deliverable Products
V. Services Excluded from Work Scope
VI. Services to be Provided by Mn/DOT
VII. Schedule
VIII. Compensation
IX. Quality Assurance / Quality Control

I. PROJECT BACKGROUND

Bridge No. 9340 (I-35W over the Mississippi River) is a primary link in the transportation network of the Twin Cities metropolitan area. The objective of this project is to identify the main truss members susceptible to fracture and evaluate the structural consequences should one of the members fail. Through this type of evaluation of Bridge 9340, Mn/DOT will be allowed to focus and refine inspection and rehabilitation efforts on those members expected to be critical - with respect to bridge stability.

We reviewed the fracture critical inspection report prepared by Pete Wilson for this bridge. His inspection was conducted between 7/28/97 and 8/4/97. The inspection report describes several bridge components that are not functioning as intended and could impact a realistic analysis of the bridge. These items include:

1) Frozen SE rocker in a cross beam
2) Span #2 joint closed beyond tolerable limits
3) Pinned connections of the sway bracing are "working"
4) Troughs under the finger joints tend to fill up with debris
5) The roller nest bearing at Pier #6 shows no sign of movement

In addition, we have reviewed a vehicular live load fatigue study prepared in 2000 by Robert Dexter. His report contains field test procedures, test results, stress analysis, fatigue life expectancy, as well as inspection recommendations.

II. QUALIFICATIONS

Dr. Steven Olson of HNTB's Minneapolis office will serve as project manager for this project. Dr. Olson has worked on a number of truss bridges or bridges with stiffening trusses (Hell Canyon – Custer, SD; East Street – Parkersburg, WV; U.S. Grant – Portsmouth, OH; Market Street – Steubenville, OH; Steel Bridge – Portland, OR; Kwang An Grand – Pusan, South Korea). While working for a previous firm, Dr. Olson developed software that performs second-order analyses of suspension bridges. This geometrically non-linear analysis is similar to that which will be required to evaluate the global stability of Bridge No. 9340 when members are assumed to fail.

Professor Robert Dexter from the University of Minnesota and Professor Stan Rolfe from the University of Kansas will serve as subconsultants to HNTB for this project. Both are nationally recognized experts on fatigue and fracture. Professor Dexter brings an intimate working knowledge of the bridge as a result of his past experimental studies on the bridge; his services will contribute significantly to the vehicular live load impact on the primary bridge members. Professor Rolfe will add considerable assistance in the development of failure criterion for the members.

Carl Osberg of HNTB will serve as a design engineer for this project. In pursuing his M.S. degree under Dr. Robert Dexter at the University of Minnesota, he conducted fatigue-related analyses of modular bridge joint systems. In addition, Carl has served as a design engineer for numerous structural projects and has considerable experience in non-destructive testing.

The structural assessment of Br. No. 9340 requires sophisticated tools and experience. In addition to a talented staff of professionals in the Minneapolis office, HNTB has the resources of a national firm with more than 2,600 employees. Of specific interest to this project is our group of programmers in the Kansas City office. We have experienced bridge engineers available to develop customized applications, which can streamline and automate the analysis of bridge structures. As a member of the Kansas City programming group, Don Kruse has noteworthy experience in the development of inelastic structural analysis software. HNTB's software is capable of solving models with non-linear material properties and non-linear geometric considerations, both of which will be required for this project. Some of the software that will be utilized throughout this project includes – STAA Pro 2001, Microstation, T187, PCACOL, BDGS, and Microsoft Office.

Resumes for Dr. Olson, Dr. Dexter, Dr. Rolfe, Don Kruse, and Carl Osberg are given in Attachment B as further demonstration of their credentials.

III. SCOPE OF SERVICES

HNTB will evaluate the potential consequences and effect on the structural stability of Br. No. 9340 related to failure of selected main truss members. This evaluation will be completed through investigating previous bridge studies and using survey measurements, numerical analysis and structural modeling of the bridge as described herein. Our project approach is presented with six major work tasks.

1) **Collect bridge traffic data.**

   Mn/DOT will provide traffic history information to aid us in this process. Average Daily Traffic (ADT) numbers, Average Daily Truck Traffic (ADTT) percentages, and permit vehicles records, if available, for the bridge will be assembled to estimate the expended fatigue life of primary truss members.

2) **Assemble and calibrate three-dimensional space frame model of the bridge.**
   a. We intend to construct a three-dimensional space frame model of the bridge. The space frame model will permit us to examine bending effects, in an effort to highlight regions where peak stresses would be anticipated. The three-dimensional model also permits us to examine the impact of lateral bracing, sway bracing, and other elements that may not have been considered in the original design of the bridge in the 1960s.
   b. We intend to attach survey targets to the bridge and observe the thermal displacements of the bridge over a period of time no less than six months. This would permit the movements of the bridge to be collected for a range of temperatures.
   c. Using the movements collected with the surveys, the local behavior of certain members (collected in Professor Dexter's studies), as well as, addition information noted in past studies and inspections we intend to calibrate the structural model of the bridge. The movement or lack of movement at joints and bearings may have a significant effect on the forces introduced into primary truss members. By adjusting the boundary conditions of the model to approximate the observed behavior, the calibrated model will be used to produce a refined estimate of the remaining fatigue life of the primary truss members. Moreover, the calibrated model will allow evaluation of the bridge stability with various members removed. A number of model adjustments are possible. They include adding spring elements to the supports to represent less than perfect roller conditions, placing compression only elements in joints that tend to fill with debris, etc.

3) **Select the live load vehicles to be considered in the remaining analysis.**

   We will review selected recent literature pertaining to the observed weights of trucks on interstate highways. After reviewing the literature and the live loads specified in various AASHTO documents, we will prepare a document that lists five potential live load configurations that potentially could be applied to the model. Pros and cons for each of the load types will be identified in the document.

After submitting the document to you, we will meet with you to discuss the merits of the different live load configurations and to select three to be carried forward in the evaluation of the bridge. We anticipate that one live load configuration will be used for fatigue evaluation, a second live load will be used for tensile strength evaluation, and the third will be at Mn/DOT's discretion.

4) **Capacity criteria for individual truss members.**

Based on information contained in the construction drawings and material records available for the bridge, tension capacities, compression capacities, and fatigue thresholds of primary truss members will be calculated. The calculated capacities will be used to identify critical members and to evaluate whether or not a member is functioning after removal of another member in the bridge.

5) **Identify Critical Members.**

Using the calibrated three-dimensional model and the selected live loads to be applied to the bridge, eight critical members will be identified. The reason eight critical members have been chosen is two-fold. First, the feasibility of rehabilitation of more than eight members is an expensive and complex process. Secondly, the scope of this project needs to contain set limits on the amount of work to be completed. Four of the eight members will be identified based on fatigue considerations. They will be the members that experience the largest live load stress ranges. The remaining four members will be tension members whose tension capacity is most closely reached when subjected to dead plus live load. We anticipate a second meeting with Mn/DOT at the conclusion of this task to discuss the specific members identified as critical and the survey data/report.

6) **Analysis with members removed.**

After the eight critical members have been identified and Mn/DOT has concurred with the selection of the members, a sequential analysis will be performed using the calibrated three-dimensional model. A total of eight analyses will be performed. For each analysis one of the eight critical members will be removed from the computer model. With only dead load applied to the model, the structure will be evaluated to determine if redistribution of dead load generates member forces that exceed the capacity of the remaining members. If additional members fail the analysis will be stopped. On the other hand, if there is additional capacity in the bridge, live load intensities will be increased until a second member fails. A summary document will be prepared which describes the impact of removing each of the eight critical members.

IV. DELIVERABLE PRODUCTS

HNTB will provide to Mn/DOT the following deliverables/products as instruments of service associated with the scope of services described herein:

- Report of Findings - Observed Thermal Movements of the Bridge – 2 black and white copies
- Live Load Configurations for Consideration for the Structural Evaluation of Bridge No. 9340 – 2 black and white copies
- Identification of Eight Critical Primary Truss Members – 2 black and white copies
- Report of Findings – Structural Evaluation of Bridge No. 9340 – 2 black and white copies
- Bound and indexed structural assessment calculations – one copy.

V. SERVICES EXCLUDED FROM WORK SCOPE

- **Verification of Structural Members**: HNTB will not be responsible for comparison of the actual structural members to those depicted on the construction drawings. HNTB will use the members as described within the construction drawings.
- **Bridge Inspection and Condition Survey**: HNTB will not be responsible for inspection of the bridge as a whole or in part, or for inspection of individual structural members and elements of the bridge. No attempt will be made to determine the location, or extent of corrosion, misalignment, or condition of structural members or their connections. HNTB will not be responsible for destructive, or non-destructive testing of the bridge elements or the bridge materials.
- **Dimension Survey:** HNTB will not be responsible for determination of the overall geometry of the structure as it relates to settlement, differential settlement, or out-of-plumb conditions of the substructure units.
- **Deck/Substructure/Foundation Evaluation:** HNTB will not be responsible for assessment of the bridge deck, substructure units or foundation elements of the bridge. HNTB will base its analysis and computer models on construction drawings with the assumption that the bridge deck, substructure units and foundations were constructed as shown on the construction drawings; no significant scour has occurred; and, the substructure and foundations are performing as intended by the designer.
- **Load Rating:** HNTB will not be responsible for determination of the bridge's load rating.
- **Remedial Measures:** HNTB will not responsible for evaluating the options available to address deficiencies determined during the course of the structural stability assessment described herein.
- **Cost Estimates:** HNTB will not be responsible for estimating the initial cost of repairs or other remedial measures as occasioned by the findings of the services described herein.

VI. SERVICES TO BE PROVIDED BY MN/DOT

HNTB and Mn/DOT mutually agree that Mn/DOT will provide services or products associated with the project as described with Section VI.

1. Participate in project meetings.
2. Review and comment on HNTB submittals in a timely manner.
3. Grant HNTB the right to access Mn/DOT facilities (Br. No. 9340) and adjacent property as needed to survey the movement of the bridge.
4. Provide two sets of 8 ½ x 11 photocopies of all construction documentation, such as: pile driving records, material records, shop drawings, and construction observation reports.
5. Provide two copies of all maintenance reports for the existing bridge.
6. Provide two sets of 11x17 construction drawings for the existing bridge.
7. Provide use of a snooper truck to gain access to the bridge for purposes of placement of survey targets if climbing methods cannot be used to place survey targets.

VII. SCHEDULE

Our anticipated work schedule is shown in the Gantt Chart of Attachment D. HNTB will commence work within 30 calendar days of notice-to-proceed and provide services in accordance with the following schedule:

- Capture Global Behavior of the Bridge within 175 business days of notice to proceed.
- Develop 3-D computer model with frame members within 40 business days of notice to proceed.
- Calibrate the 3-D computer model within 190 business days of notice to proceed.
- Select live loads to be used within 100 business days of notice to proceed.
- Develop failure criteria within 140 business days of notice to proceed.
- Identify selected critical members within 200 business days of notice to proceed.
- Perform failure analysis within 235 business days of notice to proceed.
- Deliver final report of findings within 260 business days of notice to proceed.

VIII. COMPENSATION

Our estimated cost for this project is $126,135. We propose a lump sum agreement for our services. A detailed breakdown of our estimated costs is provided in the spreadsheet table of Attachment C.

IX. QUALITY ASSURANCE / QUALITY CONTROL

Checks for quality are incorporated into the fabric of HNTB's standard work practices. Structured checking procedures are in place for personnel in all classifications, from CAD technicians to project managers. In addition, project managers are required to hold monthly progress meetings, which internally address questions about his or her project's progress, budget, schedule, and client satisfaction.

How will quality be defined for the evaluation of Bridge No. 9340? We perceive the quality parameters require a structural evaluation that:

- Is technically sound. To ensure that this quality measure is met, we've added nationally recognized experts to our team to guide and review our efforts.
- Uses state-of-the-art analytical tools. Our T187 program has the ability to model and analyze non-linear material and geometric behavior. In addition, our programmers in Kansas City can tailor the program for specific projects.
- Is presented in documents that are easy to read, understand, and follow. Our document figures will be completed in Microstation, so they are compatible with Mn/DOT practices.
- Is thoroughly checked by experienced engineers. Because of its sensitive nature, work products for this project will be checked by bridge engineers with more than 10 years of experience.
- Is within budget and on time. The schedule and compensation attachments are realistic and well defined.

If desired, additional information can be provided to Mn/DOT describing HNTB's standard QA/QC plans and policies, which are used for each HNTB project.

STEVEN A. OLSON, PHD, PE

Education

BS, University of Minnesota, 1985, Civil Engineering

MS, University of Minnesota, 1989, Civil Engineering

PhD, University of Minnesota, 1991, Civil Engineering

Registration

Professional Engineer: Minnesota, Ohio (1992)

Affiliations

ASCE

National Cooperative Highway Research Project 24-10 Panel;
"Thermally Sprayed Metallic Coatings to Protect Steel Pilings"

Transportation Research Board Committee A2F07;
"Fabrication and Inspection of Metal Structures"

Date Hired w/ HNTB

10/21/98

Years of Experience as of 1/01

HNTB: 3
Other: 12

Experience

Steve is a Registered Professional Engineer with more than 14 years of structural engineering experience as a designer, inspector, analyst, researcher, manager, and educator. This experience includes full scale structural testing, the development of structural analysis software, and a variety of bridge related projects on both a system and individual project level. Some of his most recent project experience includes:

LRFD Bridge Design Manual – Active Project (4/00 start, anticipate 11/01 completion)
Minnesota Department of Transportation, St. Paul, MN

Steve is the project manager for the development of a document that clearly presents Mn/DOT's policies, guidelines and practices for the final design of bridges. The document will be based on AASHTO's LRFD Design specifications, utilize customary units, and incorporate pertinent sections of Mn/DOT's existing bridge design manual. Twelve design examples will be included in the manual. The examples will illustrate the design of various bridge superstructure and substructure components. The manual will be made available to Mn/DOT, county and municipal transportation agencies for the production of final bridge plans.

Hell Canyon Bridge – Active Project
Custer County, South Dakota (3/99 start, anticipate completion 12/01)

A winding canyon road on US 16 will be bypassed when the Hell Canyon Bridge is completed. The structure will have two short girder spans flanking a three span continuous deck truss (spans of 66', 552', 760', 552', 66'). The center piers for this bridge will have a heights of 211' and 139'. Steve is designing the substructure units and performing an independent review of the superstructure. The client for this project is the South Dakota Department of Transportation.

Veteran's Park Pedestrian Bridge
River Falls, Wisconsin (12/00)

A two span double tee pedestrian bridge over the Kinnickinnic River exhibited extensive deterioration in its superstructure. Steve collected field observations and performed a capacity analysis which led to a recommendation to close the bridge. The client for this project was the City of River Falls.

Infrastructure Systems Engineering 5301 - (Fall Semester 2000)
Bridge Management, Maintenance, and Rehabilitation
University of Minnesota
Minneapolis, Minnesota

Steve developed and delivered a graduate school course for students enrolled in the *Infrastructure Systems Engineering* program in the Center for the Development of Technological Leadership. The 2 credit course covered bridge funding, the fabrication of different bridge elements, inspection of pedestrian bridges, load rating of existing bridges, and a final project which utilized the National Bridge Inventory.

Glen Park Swinging Bridge (6/00 – 9/00)
River Falls, Wisconsin

Originally constructed in 1925 and later rehabilitated in 1985 the Glen Park Swinging Bridge is a suspension pedestrian bridge over the South Fork of the Kinnickinnic River. Steve performed an in-depth inspection and survey of the bridge. The client for this project was the City of River Falls.

Eaton Street Dike (9/99-6/00)
St. Paul, Minnesota

As part of a flood control project, a sheet pile dike and closure structure will protect the St. Paul Airport. Steve was project manager of the final design of the structural elements. In addition to a closure gate across Union Pacific Railroad tracks, over 500 feet of sheet pile dike were designed. This included spliced sections to be installed under an active highway bridge. The client for this project is the Metropolitan Airports Commission.

1st Street South Bridge
Minneapolis, Minnesota (4/99-1/00)

The replacement structure for the 1st Street South Bridge in the St. Anthony Falls National Historic District of Minneapolis is a steel through girder bridge. The new simple span bridge reused floor beams and one of the abutments from the prior structure. An abutment with extensive architectural treatments and an ornamental railing were incorporated into the new structure. Steve performed construction engineering services. The client for this project was the City of Minneapolis.

MSP International Airport Airside Tunnels, (10/98 – 8/99)
Minneapolis, MN

Steve served as a design engineer for the preliminary design of two tunnels to carry vehicular traffic beneath various runways and taxiways at the Minneapolis – St. Paul International Airport (MSP). These tunnels will be constructed using a cut and cover technique and will carry aircraft loading within the secure area of the airport. Steve's specific MSP tunnel involvement includes:

- **MSP Tunnel 17-35** – Steve served as a design engineer adhering to FAA and AASHTO standards in preliminary design
- **MSP Tunnel 4-22** – Steve served as a design engineer adhering to FAA and AASHTO standards in preliminary design

Steel Bridge Market Assessment Report
National Steel Bridge Alliance, *U.S.A.* (3/98-5/98)

In an effort to benchmark the steel bridge market, Steve prepared a report for the Executive Council of the National Steel Bridge Alliance. The National Bridge Inventory was obtained from the FHWA and queried as a database. Recent FHWA spending reports were also used to prepare the report. The report summarized the steel bridges currently in service in the U.S., recent construction trends (market shares, construction spending), and the potential bridge market on a state by state basis.

Edge/Corner Grinding Research Project
Minneapolis, MN (2/97-9/98)

Steve was the Project Manager for a steel industry research project. The purpose of the project was to quantify the amount of corner preparation necessary prior to painting steel elements. The project evaluated 9 paints on 5 different corner conditions. 5,000 hours of salt fog testing was used to evaluate performance.

Kwang An Grand Bridge
PUSAN, KOREA (8/96-12/96)

Steve was the Analysis Coordinator for a team of engineers evaluating the towers, stiffening truss, and anchorages of a 900 meter (2,953 foot) suspension bridge. The three-span, double decked structure has a main span of 500 meters (1,640 feet). The client for this project was the Dong Ah Construction Industrial Company.

East Street Bridge
Parkersburg, West Virginia (10/93-3/96)

Steve was the primary bridge designer of a new 400-foot through truss. The truss carries West Virginia Route A14 over the Little Kanawha River and was designed without sway bracing. This required that lateral wind loads be resisted by frame action. Steve also performed shop drawing review and construction engineering services. The client for this project was the West Virginia Department of Transportation.

U.S. 119 Bridge
Holden, West Virginia (11/92-5/95)

The U.S. 119 bridge is a spliced bulb-tee girder bridge with integral pier caps. Steve performed the superstructure design and checked the design of the piers. The bulb-tee girders for the seven span, 1,200-foot superstructure were 8'-6" tall and were pretensioned and post-tensioned. Steve also performed shop drawing review and construction engineering services. The client for this project was the West Virginia Department of Transportation.

Anthony Wayne Bridge
Toledo, Ohio (6/94-1/95)

The Anthony Wayne Bridge is one of the primary crossings over the Maumee River in Toledo. As part of the rehabilitation of the bridge, Steve designed suspender and tie-down cable replacement details for this 1,250-foot suspension bridge. He was also involved in the inspection of the bridge, which required the use of adapted rock climbing techniques and man lifts. The client for this project was the Ohio Department of Transportation.

Programs LDA_TRUS and LDA_LOAD (software development)
(9/91-11/91)

In order to accurately load rate suspension bridges, Steve developed in-house software. The programs perform second-order (geometrically nonlinear) analyses based on the stiffness method. The initial strain offsets between members, thermal loadings, and a truck load generator were incorporated into the software. The programs were used on four suspension bridges with main spans over 600 feet.

U.S. Grant Bridge
Portsmouth, Ohio (11/92-4/93)

The U.S. Grant bridge is a two lane bridge over the Ohio River. Steve performed a load rating analysis of this 1,400-foot suspension bridge, which has a continuous stiffening truss. The analysis included the effects of an unintended sag of 19-inches in the main span. Steve also participated in this bridge's inspection using adapted rock climbing techniques. The client for this project was the Ohio Department of Transportation.

Broadway Bridge
Portland, Oregon (7/94)

Steve performed a load rating analysis of this double-leaf bascule truss bridge over the Willamette River. The client for this project was the Oregon Department of Transportation.

Memorial Bridge
Springfield, Massachusetts (3/93-4/93)

This historic seven-span concrete arch bridge was extensively rehabilitated. In an effort to minimize the construction period and maximize the contractor's operations, Steve evaluated three different construction sequences. The client for this project was Daniel O'Connell's Sons.

Bridges Inspections
Multnomah and Clackamas Counties, Oregon (4/92-6/94)

Steve was an inspection team leader for approximately 120 small bridge inspections and a team member for adapted rock climbing inspections of the Hawthorne, Burnside, Morrison, and Broadway Bridges over the Willamette River in Portland, Oregon. The client for this project was the Oregon Department of Transportation.

Hunter's Camp Road Bridge, Phase 1 and Phase 2
Columbiana County, Ohio (2/96-3/96)

Steve performed two tasks for this project. Phase 1: Evaluated the capacity of a CONSPAN culvert under thirty feet of fill. The original structure was severely distressed and failed after three months of service. Phase 2: Generated reinforcing details and evaluated the capacity of a "liner" structure placed inside of the original structure. The client for this project was Columbiana County

Bridge Management System
State of Ohio (11/92-9/94)

In addition to developing an algorithm to generate PONTIS "CoRe" element data from existing Ohio bridge inventory data, Steve assumed a quality assurance role. The clients for this project were the Battelle Memorial Institute and the Ohio Department of Transportation.

Union Pacific Corporation – Missouri Pacific Railroad / Bridge Modification
Rapides Parish, Louisiana (6/91-8/91)

A deformation analysis was required of the contractor during construction of a railroad lift bridge in Louisiana. Steve performed the analysis, which estimated the deflection of the towers when the counterweights were added to the bridge. The 100-foot-tall towers were capped with 10-foot-tall plate girders, which contained numerous cutouts and stiffeners. Measured deflections were within 1/16" of the predicted. The client for this project was the Johnson Brothers Corporation.

Full-scale Structural Testing University of Minnesota
Minneapolis, Minnesota (8/86-5/91)

As a research assistant, Steve conducted full-scale load tests on four 20-year-old AASHTO Type III girders. Each of the 64-foot-long prestressed girders was subjected to static and fatigue loadings and subsequently loaded to failure. He participated in the full-scale testing of steel joists, semi-rigid connection assemblages, reinforced concrete beams, and reinforced masonry beams. He also developed test software, which performed data acquisition and actuator control operations. The tests incorporated a variety of instrumentation including load cells, strain gages, inclinometers, and LVDTs.

Steel Industry Bridge Project Reviews (1997-1998)

As Manager of Engineering Design for the National Steel Bridge Alliance, Steve participated in or coordinated the industry review of several complex steel bridges. Project reviews were conducted for:

U.S. 231 over the Ohio River & Indiana 66, Owensboro, Kentucky

This is bridge, a 2,200' cable-stayed bridge, was successful against a concrete alternate

Denver Public Works Project No. 96-352 Speer Boulevard over South Platte River

Twin tied-arch main spans.

Ohio Department of Transportation Project WAS-124-6.79
Ohio Route 124 over the Little Hocking River

A galvanized deck truss with rolled beam members.

Illinois Department of Transportation Structure Number 016-1009
Damen Avenue Interchange; F.A.I. Route 55, Cook County

A grade separation structure with four flared ramps.

Publications/Poster Sessions

"*Designer Challenges with the Hell Canyon Bridge*", Olson, S.A., Byers, D.D., and Lyon, R.H., New York Bridge Conference 2001, New York, NY, Poster Session

"*Bridge Type Selection for US 16 over Hell Canyon*", Lyon, R.H., Byers, D.D., and Olson, S.A., International Bridge Conference Proceedings, June 2000, Pittsburgh, PA

"*The Evolution of Suspension Bridge Analysis and Load Rating the U.S. Grant Bridge*", Olson, S.A., Ohio Transportation Engineering Conference Proceedings, Columbus, Ohio, November 1993

"*Prestressed Concrete Girders after 20 Years in Service*", Olson, S.A., French, C.W., and Leon, R.T., ASCE Structures Congress, U.S.-European Workshop on Bridges 1990

"*Reusability of 20-Year-Old Prestressed Bridge Girders and the Effectiveness of Techniques to Repair Impact Damage*", Leon, R.T., French, C.W., Olson, S.A., and Coggins, F.B., Bridge Research in Progress, National Science Foundation, Des Moines, Iowa, September 1988

Training

Senior Personnel Orientation – 2000
Chicago, Illinois, HNTB

Inter-office Project Management – 2000
Chicago, Illinois, HNTB

Project Management Training – 1999
Milwaukee, Wisconsin, HNTB

Engineering Leadership Institute – 1996
Columbus, Ohio, Ohio Society of Professional Engineers

Project Management Training - 1994/1995
Columbus, Ohio, Burgess & Niple, Limited

Design and Construction of Segmental Concrete Bridges Seminar – 1994
Sacramento, California, American Segmental Bridge Institute

3-day Bridge Inspection Seminar - 1992
Loudonville, Ohio, Ohio Department of Transportation

Climbing Training for Bridge Inspection - 1992
Columbus, Ohio, Burgess & Niple, Limited

Robert J. Dexter, PhD, PE

University of Minnesota
Department of Civil Engineering
122 CivE, 500 Pillsbury Dr. S.E.
Minneapolis, MN 55455-0116
(612) 624-0063
FAX: (612-) 626-7750

EDUCATION

Ph.D. in Civil Engineering, The University of Texas at Austin, 1992
Dissertation Title: "Investigation of Criteria for Ductile Fracture under Fully-Plastic Conditions",
Advisor: Karl H. Frank.
M.S. in Civil Engineering, The University of Texas at Austin, 1986
Thesis Title: "Underwater Wet Welds: Mechanical Properties and Design Guidelines",
Advisor: Karl H. Frank.
B.S. in Civil Engineering, The University of Texas at Austin, 1981, with Highest Honors Studied
Atmospheric and Oceanic Science, University of Michigan, 1974-1977.

RESEARCH INTERESTS

Fatigue and fracture of structures.
Design, fabrication, and behavior of bolted and welded connections.
Wind loading and dynamic behavior of structures.
Repair of damaged and deteriorated structures.

TEACHING EXPERIENCE

Structural Analysis
Construction Materials
Steel Design
Advanced Steel Design
Structural Dynamics
Fatigue and Fracture of Structural Connections

PROFESSIONAL ACTIVITIES

Registered Professional Engineer since 1985, Penn. License PE-044963-R, Idaho 8031.
Member of American Society of Civil Engineers, Committee on Fatigue and Fracture.
Member of American Welding Society
Affiliate of Transportation Research Board:
Steel Bridge Committee, Bridge Movements Committee
Member of the American Railway Engineers and Maintenance of Way Association (AREMA)
Member of the Research council on Structural connection (RCSC)

EXPERIENCE

University of Minnesota, Associate Professor, Department of Civil Engineering, 1997-
Lehigh University, Senior Research Engineer, 1991-1997
Southwest Research Institute (San Antonio), Senior Research Engineer, 1981-1991

HONORS AND AWARDS

1999	Outstanding Professor, Institute of Technology Student Board
1996	Winner, SAC Analysis Contest, SAC Steel Project.
1996	Best Technical paper, ACI 4th World Congress on Joints and Bearing for Concrete Structures, "Fatigue Design and Testing of Modular Bridge Expansion Joints".

PUBLICATIONS

1. "Through-thickness Properties of Column Flanges in Welded Moment Connections", by R.J. Dexter and M.I. Melendrez, ASCE Journal of Structural Engineering, Vol. 126, No. 1, pp. 24-31, January 2000.

2. "Behavior of Long fatigue Cracks in a Cellular Box Beam", by A.C. Nussbaumer, J.W. Fisher, and R.J.Dexter, ASCE Journal of Structural Engineering, Vol. 125, No. 11, pp. 1232-1238, November 1999.

3. "Fatigue Design of Modular Bridge Expansion Joint" by R. J. Connor and R.J. Dexter, Transportation Research Record, No. 1688, Trans. Research Board, pp. 124-130,1999.

4. "The Development of Fatigue Design Load Ranges for Cantilevered Sign and Signal Support Structures", by K.W. Johns and R. J. Dexter, Journal of Wind Engineering and Industrial Aerodynamics, 77&78, pp. 315-326, 1998.

5. "Finite-Element Calculation of Applied J-Integral for Cracked Ship Structural Details", by D. Xiao and R.J. Dexter, Engineering Fracture Mechanics, Vol. 60, No. 1, pp. 59-82, 1998.

6. "Field Study of Pretension in Large Diameter a490 Bolts", by C.J. Oswald, R.J.Dexter, and S.K. Brauer, ASCE Journal of Bridge Engineering, Vol. 1, No. 3, August1996.

7. "Full-Scale Experiments and Analyses of Cellular Hull Sections in Compression, by R.J. Dexter, J.M. Ricles, L-W. Lu, A.A. Pang, and J.E. Beach, ASME Journal of Offshore Mechanics and Arctic Engineering, Vol. 118, No. 3, Aug. 1996.

8. "Measured Imperfection and Their Effects on Strength of Component Plates of a Prototype Double Hull Structure", by A.A. Pang, R. Tiberi, L-W. Lu, J.M. Ricles, and R.J. Dexter, Journal of Ship Production, Vol. 11, No. 1, pp. 47-52, Feb. 1995.

9. "High Performance Steel for American's Bridges", by J. W. Fisher and R. J. Dexter, Welding Journal, Vol. 73, No. 1, pp. 35-43, January 1994.

10. "A Computational Procedure for the Simulation of Ductile Fracture with Large Plastic Deformation," by S. Roy and R.J. Dexter, Engineering Fracture Mechanics, Vol. 45, No. 2, pp. 277-293, 1993, 1995.

Stanley T. Rolfe, PhD, PE

Department of Civil & Environmental engineering
2006 Learned Hall
University of Kansas
Lawrence, KS 66045-2225
(785) 864-3766
FAX (785) 864-5631
EMAIL: ROLFE@KUHUB.CC.UKANS.EDU

Present Position

Albert P. Learned Professor of Civil & Environmental Engineering
Department of Civil & Environmental Engineering
University of Kansas
Lawrence, KS 66045-2225

Education

Ph.D., Civil Engineering with Structural Major, University of Illinois, 1962
M.S., Civil Engineering with Structural Major, University of Illinois, 1958
B.S., Civil Engineering, University of Illinois, 1956

Professional Qualifications

Dr. Stanley T. Rolfe has been involved in a comprehensive experimental and analytical research program in fracture mechanics at the University of Kansas for 30 years. Prior to that time, he was Division Chief of the Material Behavior Division at U.S. Steel's Applied Research Laboratory in Monroeville, Pa. He has an extensive research background and considerable practical experience in the application of fracture mechanics to various fracture and fatigue problems. His research for the Pressure Vessel Research Committee and the American Iron and Steel Institute has focused on elastic-plastic fracture mechanics test development as well as fatigue and fracture control in steel structures. He has published extensively in the fields of fracture control, test development, correlations, CTOD test development, and applications of fracture mechanics.

He has written a textbook on *Fracture and Fatigue Control in Structures* co-authored by John Barsom of U.S. Steel. The Third Edition will be published in 1999. He has consulted widely on structural failures in the field of fatigue and fracture control in structures. He has worked on a special assignment for the U.S. Coast Guard on Fracture Mechanics Methodology for Fracture Control in Oil Tankers and also for ORNL regarding fracture issues, particularly regarding the effect of shallow cracks.

Academic and Research Experience

A.P. Learned Professor, Civil & Environmental Engineering Department, University of Kansas, 1998-present
Chairman and A.P. Learned Professor, Civil Engineering Department, University of Kansas, 1986-1998
Chairman and Ross H. Forney Professor, Civil Engineering Department, University of Kansas, 1975-1986
Ross H. Forney Professor, Civil Engineering Department, University of Kansas, 1969-1975
U.S. Steel Applied Research Laboratory, Monroeville, Pennsylvania, Research Technologist, Senior Research Engineer, Section Supervisor, and Division Chief of Mechanical Behavior of Metals Division, 1962-1969
University of Illinois, Research Assistant and Research Associate, 1956-1962

Honors

University of Kansas, Spahr Professorship
University of Illinois, College of Engineering *Alumni Honor Award for Distinguished Service in Engineering*, 1987
Fellow, ASCE
University of Illinois Civil Engineering Alumni Association *Distinguished Alumnus Award*, 1985
Winner of the University of Kansas *Irvin E. Youngberg Research Award* in recognition of research achievement in the field of Applied Sciences, 1985

Shared ASCE *State-of-the-Art of Civil Engineering Award* as a Member of Committee on "Fatigue and Fracture Reliability", 1983
Elected to Membership, *National Academy of Engineering*, 1982
Theodore R. Higgins Lectureship Award by American Institute of Steel Construction, Inc., 1980

Research Sponsors

American Iron & Steel Institute; Pressure Vessel Research Committee; Ship Structure Committee; Federal HighwayAdministration; National Bureau of Standards, Kansas Department of Transportation

Major Consulting Assignments

Standard Oil of California
The Boeing Company
Caterpillar Manufacturing
Bethlehem Steel Corporation
Brown and Root Construction
U.S. Coast Guard
Nuclear Regulatory Commission
American Iron and Steel Institute
HNTB Corporation
Madison Gas and Electric Co.
Sun Shipbuilding and Dry Dock Co.
Cailfornia Department of Transportation
U.S. Army Construction Engineering
Lincoln Electric

Professional Activities

Member, Technical Advisory Panel for SAC/FEMA Northridge Earthquake Review Panel, 1996
Chairman, Special Committee on Application of Fracture Mechanics to Solution of Cracking in Trans-Alaskan Pipeline Service
Tanks, Special Working Group of U.S. Coast Guard and Industry
Lecturer and Consultant, Significance of Cracking in Nuclear Pressure Vessels, Oak Ridge National Laboratories
Chariman, AASHTO Technical Committee T-14, Weathering Steel Study Group
Special Reviewer, Special Committee of the U.S. Coast Guard on Storm Relief of Cargo Tankers
Chairman, American Society of Civil Engineers Technical Committee on Fracture and Structural Fatigue
Member, National Research Council Project Advisory Committee
Member, National Materials Advisory Board Committee on Applications of Fracture Mechanics Analysis Techniques to Marine Systems
Project Investigator, Pressure Vessel Research Committee on Effective Utilization of Yield Strength
Member, American Society of Testing and Materials Committee E-08 on Fracture Testing of Metals

Selected Publications

Barson, J.M. and Rolfe, S.T. "Fracture and Fatigue Control in Structures – Applications of Fracture Mechanics, Third Edition, ASTM, 1999.

Rolfe, S., "Fracture Mechanics Testing for Structural Steels," *Cement, Concrete, and Aggregates*, CCAGDP, Vol. 19, No. 2, Dec. 1997, pp. 92-102.

W.H. Munse and S.T. Rolfe, "Fatigue, Brittle Fracture, and Lamellar Tearing" Chapter in *Structural Engineering Handbook*, McGraw-Hill, 1997.

Jeff Smith and Stan Rolfe, "The Significance of Crack Depth (a) and Crack Depth to Width Ratio (a/W) with Respect to the Behavior of Very Large Specimens, " PVP Division, ASMF, *Journal of Pressure Vessel Technology*. Vol. 119, Aug. 1997, pp. 279-287.

Jeffery A. Smith and Stanley T. Rolfe, "An Analytical Investigation of the Effect of Crack Depth (a) and Crack Depth to Width (a/W) Ratio on the Fracture Toughness of A533-B Steel", Fatigue and Fracture Mechanics 27th National Symposium on Fracture Mechanics, ASTM STP 1296, 1997, pp. 175-200.

S.T. Rolfe, K.T. Ilays, and A.E. Henn, "Fracture Mechanics Methodology for Fracture Control in VI.CC's "SNAME Ship Structures Symposium '93, November 16-17, 1993, Arlington, VA.

S.T. Rolfe, "Fitness for Service – Common Sense Engineering, " Special Symposium on *the Art and Science of Structural Engineering* honoring William J. Ilall, University of Illinois, April 25-27, 1993.

D.K.M. Shum, T.J. Theiss, and S.T. Rolfe, "Application of J-Q Fracture Methodology to the Analysis of Pressurized –Thermal-Shock in Reactor Pressure Vessels," presented at the 24th ASTM National Symposium on Fracture Mechanics, June 30-July 2, 1992, Gatlinburg, TN, ASTM STP 1207, 24th National Symposium, 1994.

T.J. Theiss, D.K.M. Shum, and S.T. Rolfe, "Interim Results from the HSST Shallow-Crack Fracture Toughness Program," presented a the 24th ASTM National Symposium on Fracture Mechanics, June 30-July 2, 1992, Gatlinburg, TN, ASTM STP 1207, 24th National Symposium, 1994.

S.T. Rolfe, W.A. Sorem, and R. II. Dodds, "An Analytical Comparision of Short Crack and Deep Crack CTOD Fracture Specimens of an A-36 Steel,"; The Effects of Crack Depth on Elastic-Plastic CTOD Fracture Toughness," and "A Comparison of the J-Integral and CTOD Parameters for Short Crack Specimen Testing," Welding Research Council Bulletin No. 351, February 1990. "Effects of Crack Depth…," also Published *by International Journal of Fracture*, No. 47, 1991, pp 105-126,"A Comparison of the J-Integral…," also published by American Society for Testing and Materials, 1991.

S.T. Rolfe, W.A. Sorem, and G.W. Wellman, "Fracture Control in the Transition-Temperature Region for Structural Steels." *Journal of Constructional Steel Research*, 13, 1989, pp 171-195.

J.M. Barsom and S.T. Rolfe, "Fracture Mechanics in Failure Analysis," ASTM STP 945,1988.

DONALD KRUSE, Ph.D., P.E.

Lead Engineering Programmer

Education	Ph.D., Mathematics; University of Kansas, 1974 M.S., Engineering; University of Kansas, 1977
Professional Registration	P.E. Kansas: 1984

Dr. Kruse joined HNTB in 1978 and worked for 10 years as a bridge designer before transferring to the firm's Technology Group (formerly Technical Computer Systems) in 1988. He is responsible for dynamic structural analysis of major projects and serves as a liaison engineer between the structural engineering and computer departments on the development of in-house programs for complex structural design and analysis.

Since joining the firm's Technology Group, Dr. Kruse has been instrumental in the development of the following applications:

BENT—Dr. Kruse developed this application which designs pier caps and columns. The program also generates the input for a spread or pile footing design program named BENTFOOT.

COLUMN---Dr. Kruse developed this program for the design of columns whose cross-sections may be any shape enclosed in a sequence of straight lines or circular arcs.

BDGS---Dr. Kruse wrote the steel girder design and rating portion of this design and graphics system. LRFD capabilities currently are being added to the program.

SPLICE—Dr. Kruse developed this steel girder splice design program which takes data from BDGS as input to design bolded field splices.

GENPFACE—Dr. Kruse wrote this program which is used to generate 3D drawings of bridges for type studies. These script files are imported into AutoCAD and the images are subsequently superimposed on to scanned photographs of the bridge site. GENPFACE also is used to check clearances in a multiple level interchange.

UBEAM_FIT—A program written to optimize the placement of U-beams and their cap beams given the roadway geometry, UBEAM_FIT was developed by Dr. Kruse.

T187— T187 is a matrix structural analysis program based on the direct stiffness method. This program is used for erection analysis of concrete and steel structures, including creep and shrinkage of the concrete. Dr. Kruse also added dynamic time history analysis for earthquake analysis to this program.
T126A—Responsible for the re-writing of this steel girder design rating and analysis program for firm-wide use.

Bridge Design System--Designed software system for design, analysis, and graphics generation of bridge details.

While working as an engineer, Dr. Kruse gained extensive bridge experience from projects including:

Roosevelt Lake Bridge; Gila County Arizona—Aerodynamic analysis for a 2,000-foot steel arch bridge (1,200-foot main span) in rugged terrain.

Hennepin Avenue Mississippi River Bridge; Minneapolis, Minnesota—Aerodynamic analysis and design of stiffening girder and suspension cable system for a replacement Mississippi River bridge.

Glade Creek Bridge; Raleigh County, West Virginia—Large deflection analysis of tall columns.

Lake Street/Marshall Avenue Mississippi River Bridge; Minneapolis, Minnesota–Erection analysis of arch, spandrels, and deck.

Alsea Bay Bridge; Waldport, Oregon–Computer analysis of erection of arches and delta piers.

I-70 French Creek Viaduct; Glenwood Canyon, Colorado–Computer analysis of erection.

Luling Bridge; Luling, Louisiana--Complete modeling for dynamic analysis of a cable-stayed steel girder bridge, spanning the Mississippi River, with a 1,222-foot center span. The bridge was designed by another firm; the superstructure contractor retained HNTB to prepare erection procedure and analyze each stage for erection stresses and aerodynamic stability.

Neches River Bridge; Port Arthur, Texas--Design check involving computer modeling for analysis of aerodynamic stability of concrete cable-stayed bridge.

Houston Ship Channel Bridge; Houston, Texas–Dynamic analysis of a segmental concrete structure with a record-setting 750-foot main span.

I-40 Mississippi River Bridge Seismic Analysis; Memphis, Tennessee--Seismic analysis using STRUDL.

I-229 Seismic Retrofit; St. Joseph, Missouri–Seismic retrofit of double-deck steel bridge in downtown area.

Double Deck Bridge Seismic Analysis; Richmond Expressway, Richmond, Virginia–Seismic Analysis using STRUDL, for steel and concrete bridge over railroad tracks in the downtown area.

Mississippi River Bridge; Natchez, Mississippi-Vidalia, Louisiana–Computer modeling for a cantilevered truss bridge with five river spans, including a 798-foot center span.

Papago Freeway Bridges; Phoenix, Arizona--Independent design checks of work performed by other consultants for a $600 million freeway project.

Saginaw River Bridge; Zilwaukee, Michigan--Computer modeling for repair of a segmental concrete bridge damaged during construction.

Mississippi River Bridge; Souix City, Iowa--Involved in developing an analysis of repair procedures for a tied arch bridge.

South Street/Columbia Street Bridge over LN and NW Railroad in the Wabash River; Lafayette, Indiana--Designed segmental concrete post-tensioned box girders.

Union Pacific Railroad Bridge at Caliente Canyon, Nevada--Analyzed the existing 125-foot truss span for standard dynamic loading.

Publications & Presentations

In addition to his work as an engineer and as an engineering programmer, Dr. Kruse co-authored a paper on Earthquake Considerations for Cape Girardeau Cable-Stayed Bridge over the Mississippi River for the ASCE Structural Congress in 1996. Dr. Kruse taught an advanced numerical methods course for the University of Kansas engineering department and taught a Matrix Structural Analysis course at the University of Missouri in Kansas City. He also has given several presentation including:

"Wind-Induced Vibrations in Long Span Bridges"
University of Missouri

"Wind Load, Tornadoes and Building Codes"
Wind Load, Tornadoes and Building Codes Conference

"Computer-Aided Shear Design of Pre-stressed Concrete Bridges"
Pittsburgh, Pennsylvania; 1986 International Bridge Conference

“Special Problems in Cable-Support Bridge Analysis”
Lawrence, Kansas; 1995 Kansas University Structural Conference

Prior to joining HNTB, Dr. Kruse taught mathematics at the University of Kansas for 10 years.

CARL B. OSBERG, EIT

Education

BS, Civil Engineering, South Dakota School of Mines and Technology, 1997

MS, Structural Engineering, University of Minnesota, 1999

Continuing Education Seminars, University of Minnesota 2000

Registration

EIT: Minnesota

Affiliations

American Society of Civil Engineers
EERI
Tau Beta Pi
Chi Epsilon

Date Hired w/ HNTB

11/8/99

Years of Experience as of 1/01

HNTB: 2
Other: 2

Experience

MSP Airside Tunnels, Minneapolis, MN

Carl is serving as design engineer for the preliminary and final design, and construction inspection, of two tunnels to carry vehicular traffic beneath various runways and taxiways at the Minneapolis – St. Paul International Airport (MSP). These tunnels will be constructed using a cut and cover technique and will carry aircraft loading within the secure area of the airport. In the shear design of the irregular structural components, Carl used the strut-and-tie method.

- **MSP Tunnel 17-35** – Carl serves as design engineer for design services
- **MSP Tunnel Y-3** – Carl served as design engineer for design services

MN/DOT LRFD Manual, Minneapolis, MN

Carl is serving as design engineer for the creation of the new LRFD MN/DOT Bridge Design Manual. He will be completing design examples and specifications for this manual. As a part of his work, Carl produced MathCad programs for the design of prestressed girders, bridge barriers, bridge bearings, and continuous concrete decks. Currently, Minnesota does not have a LRFD (Load and Resistance Factored Design) compliant manual.

Hell Canyon Bridge,
Minneapolis, MN

Carl is serving as a design engineer for the abutments for the preliminary and final design of the Hell's Canyon Bridge in South Dakota. In particular, his experience in expansion joint, anchorages, and bearings are being used.

Lock and Dam #1: Bluff Protection for US Army Corps of Engineers,
Minneapolis, MN

Carl served as a design engineer for the retaining walls at the Lock and Dam project site. Carl checked the construction tolerances of the anchor bolt spacing for the whalers (horizontal beams); and consequently, he redesigned the reinforcement in the some of the whalers to account for these tolerances.

University of Minnesota, Department of Engineering
Minneapolis, MN

While working towards his master's degree in structural engineering, Carl served as a research and teaching assistant for the department of engineering at the University of Minnesota. Some of his duties included:

- Instructed "Concrete Design" and "Matrix Analysis" classes to undergraduate students
- Coordinated National Highway Research Project 10-52 – "Performance Testing for the Durability of Modular Bridge Joint Systems"
- Designed and conducted performance tests for modular bridge joint systems (MBJS)
- Developed and prepared design, testing, installation, and fabrication specifications for AASHTO LRFD Bridge Design Manual
- Performed research on metallic fatigue, elastomeric materials, concrete anchors, bridge design and maintenance practices
- Performed field inspections of bridges
- Corresponded daily with bridge design engineers from all over the country, contractors, and bridge joint manufacturers
- Created technical drawings using AutoCad, Microstation, and Visio

South Dakota School of Mines and Technology, Department of Civil Engineering
Rapid City, SD

While working towards his bachelor's degree in civil engineering, Carl served as a research assistant for the department of civil engineering at the SDSM&T. Some of his duties included:

- Designed and tested three different fire truck sub-frames (steel, aluminum, and fiberglass) for a local fire truck manufacturing company
- Presented the three designs along with a cost analysis report to the company

South Dakota Department of Transportation
Pierre, SD

Between school sessions, Carl worked as an executive intern for the state of South Dakota Department of Transportation. Some of his duties included:

- Calibrated non-destructive testing equipment, such as an impact-echo tester, for bridge testing use
- Developed a database program that classified and analyzed South Dakota's Port of Entry truck data
- Surveyed roadway grades and alignments
- Inspected the sub-grade construction of roadways as well as the paving projects
- Investigated and sampled sub-surface materials using a drilling rig
- Performed laboratory and field material testing services

Publications

NCHRP Report 10-52 "Performance of Modular Bridge Joint Systems"

"Design, Specification, Installation, and Maintenance of Modular Bridge Expansion Joint Systems." R. Dexter, C. Osberg, M. Mutziger. ASCE Journal of Bridge Engineering, 2001.

Honors/Awards

Academic All-American
1997 ASCE Freeman Fellowship Award

ATTACHMENT C

Estimate of Hours and Costs - I-35W over Miss. - Br. No. 9340

1. Analysis and Data Collection - Estimate of Hours

	Sheet Title / Task Description	Proj. Mgr.	Prog.	Dgn. Eng.	Survey Crew	Tech. / Clerical	Total Hrs.
Global Bridge Behavior		**62**	**-**	**20**	**101**	**18**	**200**
	Set Targets	18	-	-	35	-	53
	Survey Targets - 4 times total	26	-	-	53	-	79
	Data Reduction	9	-	13	13	-	35
	Report Preparation	9	-	7	-	18	33
3-D Computer Model		**48**	**-**	**96**	**-**	**-**	**144**
	Review Existing Plans	10	-	10	-	-	19
	Determine Member Properties	10	-	29	-	-	38
	Develop Comp. Model Geometry	14	-	29	-	-	43
	Input & Verify Computer Model	14	-	29	-	-	43
Calibrate 3-D Computer Model		**16**	**-**	**32**	**-**	**-**	**48**
	Calibrate to Survey Data	8	-	16	-	-	24
	Calibrate to Strain Data	8	-	16	-	-	24
Live Load Selection		**24**	**-**	**22**	**-**	**-**	**46**
	Determine Live Load Parameters	16	-	16	-	-	32
	Meeting	8	-	6	-	-	14
Failure Criteria		**42**	**-**	**135**	**-**	**-**	**177**
	Tension Formulas	10	-	21	-	-	31
	Compression Formulas	10	-	21	-	-	31
	Connections	10	-	62	-	-	73
	Consolidate Date	10	-	31	-	-	42
Identify Critical Members		**44**	**11**	**33**	**-**	**1**	**89**
Failure Analysis		**100**	**20**	**250**	**-**	**-**	**370**
Report of Findings		**35**	**-**	**33**	**-**	**64**	**132**
	Draft Report & Graphics	26	-	26	-	57	110
	Final Report & Graphics	9	-	7	-	7	22
QA / QC		**24**	**-**	**-**	**-**	**-**	**24**
							-
		394	**31**	**621**	**101**	**83**	**1,230**

2. HNTB Estimate Direct Labor

Perc.	Labor Category	Rate		Total Hrs.		Direct Labor Cost
32%	Project Manager	$ 39.67		394	32%	$ 15,644
3%	Programmer	$ 31.65		31	3%	$ 981
50%	Design Engineer	$ 24.27		621	50%	$ 15,069
8%	Survey Crew	$ 23.74		101	8%	$ 2,402
7%	Technician / Clerical	$ 18.36		83	7%	$ 1,514

	1,230	**$ 35,610**
3. Overhead @	153.90%	**$ 54,804**
4. Profit @	15%	**$ 13,562**

5. Direct Expenses

	Item	Unit	Quant.	Price		Dir. Exp.
	Airfare	Each	1	$ 675		$ 675
	Car Rental	Each	1	$ 65		$ 65
	Hotel	Day	1	$ 85		$ 85
	Out of Town Meals	Day	1	$ 46		$ 46
	Mileage	Miles	3550	$ 0.345		$ 1,225
	Interstate Overnight Delivery Service	Each	6	$ 19		$ 114
	Survey Targets	Each	48	$ 51		$ 2,448
	Sub-consultant (Dr. Rolfe)	LS	1	$ 8,000		$ 8,000
	Sub-consultant (Dr. Dexter)	LS	1	$ 9,500		$ 9,500

$ 22,158

Total: $ 126,135

Not to Exceed Contract Amount: $ 126,135

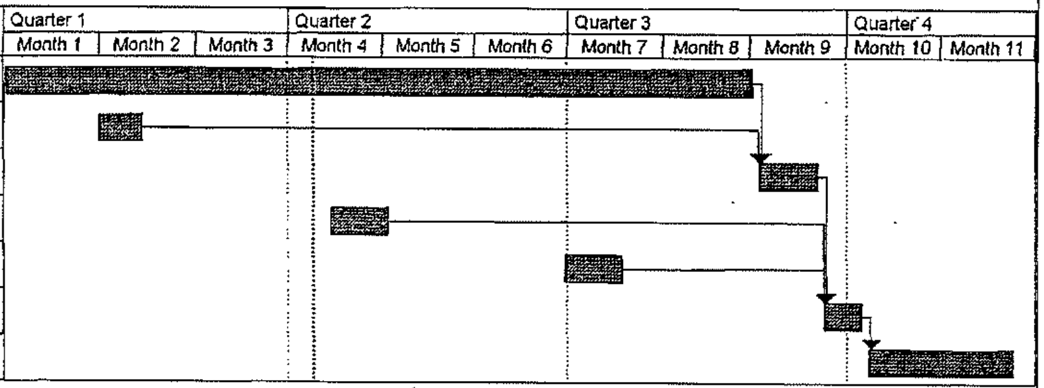
Attachment D
Page 1 of 1

ATTACHMENT D

Gantt Chart Work Schedule

Bridge 9340
35W over the Mississippi River

ID		Task Name	Duration
1	▤	Capture Global Behavior of the Bridge	175 days
2	▤	Build 3-D Model with Frame Members	10 days
3		Calibrate the 3-D Model	15 days
4	▤	Select the Live Loads to be Used	15 days
5	▤	Develop Failure Criteria	15 days
6	▤	Identify Critical Members	10 days
7		Analysis with Members Removed	35 days



Tue 10/9/01

Bergstrom, Katie J.

From: Miranowski, Jerome A. [JMiranowski@faegre.com]
Sent: Friday, May 09, 2008 1:24 PM
To: Bergstrom, Katie J.
Subject: HNTB

The statements need a couple of clarifications. HNTB can confirm the accuracy of the following:

- 1. In 1998 or 1999, MnDOT provided HNTB with plans for the I-35W Bridge. The plans consisted of 18 sheets from the original plans for the Bridge.
- 2. In HNTB's October 2001 Proposal to MnDOT, the estimated cost of the proposed services at Attachment C includes an item for the analysis of the "connections" which term includes the gusset plates.

Jerry Miranowski

LAWYER BIOGRAPHIES | PRACTICE EXPERIENCE | CONTACT US

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MINNESOTA | COLORADO | IOWA | LONDON | FRANKFURT | SHANGHAI

From: Bergstrom, Katie J. [mailto:Katie.Bergstrom@gpmlaw.com]
Sent: Thursday, May 08, 2008 3:54 PM
To: Miranowski, Jerome A.
Subject: HNTB

As we discussed, we are finalizing our Report. I don't think I need to loop back to Steve Olson or Rich Johnson for a recorded statement. But, can HNTB confirm that the following two statement are accurate:

1. In 1998 or 1999, MnDOT provided HNTB with a set of plans for the Bridge.

2. In HNTB's October 2001 Proposal to MnDOT, the scope of work at Exhibit C includes an analysis of the "connections" which term includes the gusset plates.

Thanks--

Katie

GRAY
PLANT
MOOTY

Katie Bergstrom
Attorney

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METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2007 - FINAL DRAFT (2007 Dollars) REVISED - - 01/26/06 - 02/14/06 - 02/23/06 - 03/27/06 - 06/16/06 - 06/21/06

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING / DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
						2007 Costs			
1	7265	62	109.2	EB Over Valley View Rd	Paint	$ 140,000	$ 140,000	20% Unsound --- 9,300 sf ---1981 -- Zinch Rich	1/31/2006
2	7264	62	109.2	WB Over Valley View Rd	Paint	$ 170,000	$ 310,000	30% Unsound --- 11,500 sf ---1975 -- Zinc Rich	"
3	27061	121	0.5	Under Ped at 61st ST	Paint	$ 70,000	$ 380,000	40% Unsound --- 3,800 sf --- 1962 -- Red Lead	"
4	27535	62	113.2	Under Ped at 14th Ave S	Paint	$ 50,000	$ 430,000	40% Unsound --- 3,300 sf --- 1981 -- Zinc Rich	"
5	27021	62	113.6	WB Over TH 77	Paint	$ 160,000	$ 590,000	25% Unsound --- 12,400 sf --- 1972 - Red Lead	"
6	27021	62	113.6	WB Over TH 77	Deck Repair		$ 590,000	Replace O/L and Jts; LS O/L --1979-- 7800 sf -- **Move to FY 2005 ($200,000)**	"
7	27022	62	113.6	EB Over TH 77	Paint	$ 160,000	$ 750,000	25% Unsound --- 12,300 sf ---1972 - Red Lead	"
8	27022	62	113.6	EB Over TH 77	Deck Repair		$ 750,000	Replace O/L and Jts; LS O/L --1979-- 8,000 sf -- **Move to FY 2005 ($200,000)**	"
9	27521	62	114.4	Over 28th Ave S	Paint	$ 150,000	$ 900,000	25% Unsound --- 11,300 sf---- 1964 - Red Lead	"
10	27521	62	114.4	Over 28th Ave S	Deck Repair		$ 900,000	Replace O/L and Jts; LS O/L --1979-- 7,600 sf -- **Move to FY 2005 ($200,00)**	"
11	27530	62	115.2	Under Ped at 40th Ave S	Paint	$ 60,000	$ 960,000	30% Unsound --- 3,200 sf ----1978-- Zinc Rich	"
12	27524	62	115.4	Under 43rd Ave S	Paint	$ 120,000	$ 1,080,000	50% Unsound --- 6,900 sf ----1966 -- Red Lead	1/31/2006
13	27758	394	7.5	Under Penn Ave --------------- 1.6 Mi E of Jct TH 100	Deck Repair	$ 390,000	$ 1,470,000	Replace O/L and Jts; Underdeck Repair 12,800 sf	31-Jan
14	27831	394	8.2	Over Dunnwoody Blvd 0.5 Mi W of Jct TH 94	Deck Repair	$ 920,000	$ 2,390,000	Mill and Patch-Replace glands; -LS O/L-- 1977 -- 326,000 sf	"
15	27831-A/B/C/D	394	8.2----- 8.4	Over inplace fill 0.5 Mi W of Jct TH 94	Deck Repair	$ 170,000	$ 2,560,000	Mill and Patch; --LS O/L-- 1977 -- 58,000 sf	"
ADD -- HSOP	27799L	94	231.6	TH 94 E Frontage Rd over Dunwoody Blvd	Deck Repair		$ 2,560,000	**Mill and Patch - Replace glands; HSOP $90,000**	
ADD -- HSOP	27799	94	231.6	TH94 over Dunwoody Blvd	Deck Repair		$ 2,560,000	**Mill and Patch - Replace glands; HSOP $170,000**	
16	27799R	94	231.6	EB on ramp / Dunwoody 0.1 Mi S of JCT TH 394	Deck Repair	$ 80,000	$ 2,640,000	Mill and Patch - Replace glands - L/S O/L -1987 -- 26,900 sf	"
17	27792	94	231.4	Under TH 394 at Jct 394	Deck Repair	$ 290,000	$ 2,930,000	Mill and Patch - Replace glands - L/S O/L -1977 -- 84,000 sf	"
18	27793	94	231.4	Under TH 94 NB off ramp at Jct TH 394	Deck Repair	$ 30,000	$ 2,960,000	Mill and Patch - Replace glands - L/S O/L - 1977 -- 10,500 sf	"

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2007 - FINAL DRAFT (2007 Dollars) REVISED - - 01/26/06 - 02/14/06 - 02/23/06 - 03/27/06 - 06/16/06 - 06/21/06

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
19	27794	94	231.4	Under TH 394 EB off ramp at Jct TH 394	Deck Repair	$ 30,000	$ 2,990,000	Mill and Patch - Replace glands - L/S O/L - 1977 -- 10,500 sf	"
20	27726B	94	231.3	SB off ramp/Lyndale-RR 0.3 Mi S of Jct TH 55	Deck Repair	$ 50,000	$ 3,040,000	Mill and Patch - Replace glands - L/S O/L - 1981 -- 25,300 sf	31-Jan
ADD -- HSOP	27726	94	231.3	EB off ramp/Glenwood --- 0.3 Mi S of Jct TH 55	Deck Repair		$ 3,040,000	**Mill & Patch - Replace glands/Jts - L/S O/L - 1981 47,000 sf -- HSOP $130,000**	
ADD -- HSOP	27726A	94	231.3	SB off ramp / BNSF RR --- 0.3 Mi S of Jct TH 55	Deck Repair	$ 75,000	$ 3,115,000	Mill & Patch - Replace glands/Jts - L/S O/L - 1981 25,200 sf	
ADD -- HSOP	27728	94	231.2	NB on ramp/Glenwood -- 0.3Mi N of Jct TH 12	Deck Repair	$ 220,000	$ 3,335,000	Mill & Patch - Replace glands/Jts - L/S O/L - 1981 59,700 sf	
ADD -- HSOP	27727A	94	231.2	SB off ramp/Glenwood -- 0.3 Mi N of Jct TH 394	Deck Repair	$ 125,000	$ 3,460,000	Mill & Patch - Replace glands/Jts - L/S O/L - 1981 29,100 sf	
ADD -- HSOP	27727B	94	231.2	NB off ramp/Glenwood -- 0.3 Mi N of Jct TH 395	Deck Repair	$ 135,000	$ 3,595,000	Mill & Patch - Replace glands/Jts - L/S O/L - 1981 45,400 sf	
ADD -- HSOP	27727	94	231.1	TH 94 over Glenwood - RR 0.3 Mi N of Jct TH 394	Deck Repair	$ 680,000	$ 4,275,000	Mill & Patch - Replace glands/Jts - L/S O/L - 1979 152,600 sf	
21	27942	94	205.4	2.3 Mi W of Jct TH 101	Deck Repair		$ 4,275,000	Replace O/L and Jts; LS O/L --1979-- **Move to FY 2006 ($210,000)**	
22	27943	94	205.4	2.3 Mi W of Jct TH 101	Deck Repair		$ 4,275,000	Replace O/L and Jts; LS O/L --1979-- **Move to FY 2006 ($210,000)**	
23	27020	101	41.9	NB Over Crow River	Deck Repair		$ 4,275,000	Replace O/L and Jts; LS O/L --1979-- **Move to FY 2006 ($150,00)**	
24	27873	35W	17.6	Under ramp to TH 55 SB	Rail - Deck Repair	$ 210,000	$ 4,485,000	Replace O/L and Jts LS O/L--1979 --	31-Jan
25	27874	35W	17.7	TH 55 ramp - TH 35W NB	Rail - Deck Repair	$ 180,000	$ 4,665,000	Replace O/L and Jts LS O/L--1979 --	"
26	27879	35W	17.9	Over Washington Ave	Rail - Deck Repair	$ 350,000	$ 5,015,000	Replace O/L and Jts LS O/L--1978 --	"
27	27879A	35W	17.9	SB Coll Over Wash Ave	Rail - Deck Repair	$ 180,000	$ 5,195,000	Replace O/L and Jts LS O/L--1978 --	"
28	27902	35W	17.9	NB Off Rp under Wash Av	Rail - Deck Repair	$ 200,000	$ 5,395,000	Replace O/L and Jts LS O/L--1978 --	"
29	27903	35W	17.9	NB Coll Off Ramp to 3rd	Rail - Deck Repair	$ 100,000	$ 5,495,000	Replace O/L and Jts LS O/L--1978 --	"
30	27880	35W	18	NB Coll Over Wash Ave	Rail - Deck Repair	$ 470,000	$ 5,965,000	Replace O/L and Jts LS O/L--1978 --	"
31	9340	35W	18.5	Over Mississippi River	Deck Repair	$ 3,300,000	$ 9,265,000	Replace O/L and Jts -- LS O/L--1978 -- Anti-Icing System will add additional costs	"
ADD	27888	35W	20.3	NB over Johnson St Connection	Deck Repair	$ 310,000	$ 9,575,000	Replace Overlay(1975) - Joints - Bearings	"
ADD	27887	35W	20.3	SB over Johnson St Connection	Deck Repair	$ 400,000	$ 9,975,000	Replace Overlay(1975) - Joints - Bearings	31-Jan

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2007 - FINAL DRAFT (2007 Dollars) REVISED - - 01/26/06 - 02/14/06 - 02/23/06 - 03/27/06 - 06/16/06 - 06/21/06

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
32				Various Locations	Bridge Repair	$ 1,000,000	$ 10,975,000	Misc Bridge Repair as needed. (01/26/06) Setaside reduced $1.3 M to $15.0 M	
33							$ 10,975,000		
34	62015	51	5.3	Over Como Ave	Deck Repair	$ 230,000	$ 11,205,000	Replace O/L and Jts L/S O/L--1983-- 10,400 sf - SP 6215-62011A (Jeff Morey Traffic)	1/31/2006
35	62014	51	5.1	Over BNSF Rail-Serv Rd	Deck Repair	$ 350,000	$ 11,555,000	Replace O/L and Jts L/S O/L--1983-- 15,900 sf	"
36	62013	51	4.9	Over Energy Park Drive	Deck Repair	$ 250,000	$ 11,805,000	Replace O/L and Jts L/S O/L--1983-- 11,800 sf	"
37	62012	51	4.85	Over BNSF Rail	Deck Repair	$ 350,000	$ 12,155,000	Replace O/L and Jts L/S O/L--1983-- 18,000 sf	"
38	62011	51	4.8	Over Pierce Butler	Deck Repair	$ 270,000	$ 12,425,000	Replace O/L and Jts L/S O/L--1983-- 9,500 sf	"
39	9012	51	7.6	SB Over TH 36	Deck Repair	$ 90,000	$ 12,515,000	Replace O/L & Jts-Slope Pvt Repair- O/L-1984 10,400 sf	"
40	9013	51	7.6	NB Over TH 36	Deck Repair	$ 90,000	$ 12,605,000	Replace O/L & Jts-Slope Pvt Repair- O/L-1984 10,400 sf	1/31/2006
41	27726A	94	231.3	SB off rp - BNSF & UP RR	Partial Paint	$ 175,000	$ 12,780,000	Steel Hinges -- Facia's - 1981 - Zinc Rich 54,900 sf --- Partial 14,000 sf	31-Jan
42	27726B	94	231.3	SB off rp - W Fr Rd & RR	Partial Paint	$ 250,000	$ 13,030,000	Pier Caps - Hinges - Facias - 1981 - Zinc Rich 55,800 sf ---- Partial 20,000 sf	"
43	27728	94	231.2	NB on rp-Glenwood & RR	Partial Paint	$ 300,000	$ 13,330,000	20% Unsound- Include Pier Caps - 1981 - Zinc Rich - 76,700 sf --- Partial 24,000 sf	"
44	27727A	94	231.2	NB off rp-Glenwood & RR	Partial Paint	$ 140,000	$ 13,470,000	Steel Hinges -- Facia's - 1981- Zinc Rich 17,500 sf --- Partial 11,000 sf	"
45	27727B	94	231.2	Over Glenwood & RR	Paint	$ 475,000	$ 13,945,000	25% Unsound-Include Pier Caps - 1981 - Zinc Rich -- - Partial 38,700 sf	"
46	27727	94	231.1	Over Glenwood & RR	Partial Paint	$ 380,000	$ 14,325,000	Steel Hinges- Facia's/Median - 1981 - Zinc Rich - 151,800 sf --- Partial 30,000 sf	"
47	27785	94	230.7	Under TH 55	Paint	$ 580,000	$ 14,905,000	35% Unsound - 1981 - Zinc Rich --- 46,900 sf	31-Jan
48	5895	61	117.6	Over Miss R, RR, Street	Deck Repair-Partial Paint		$ 14,905,000	Mill and Patch Deck - Misc Jt Repairs - Spot Painting Below Deck Steel **Move to FY 2008**	1/31/2006
							$ 14,905,000		
ADD	9217 E/W	494	0.4	Over Minnesota River	Scour Repair	$ 25,000	$ 14,930,000	Partnership with WRE Project. Repair of Scour Problems from Bridge Runoff	
Revisions							$ 14,930,000	**ADDITIONS ------------- 11/23/04**	
ADD	9421	94	234.8	Under Riverside Ave	Paint		$ 14,930,000	Corridor Planning with TH 94 mill and overlay **2/23/06 Moved to FY 2008**	31-Jan

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM.
FY 2007 - FINAL DRAFT (2007 Dollars) REVISED - - 01/26/06 - 02/14/06 - 02/23/06 - 03/27/06 - 06/16/06 - 06/21/06

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
ADD	9420	94	234.7	Under 25th Ave	Paint		$ 14,930,000	Corridor Planning with TH 94 mill and overlay **2/23/06 Moved to FY 2008**	"
ADD	9892	94	234.5	Under Ped at 22nd Ave	Paint		$ 14,930,000	Corridor Planning with TH 94 mill and overlay **2/23/06 Moved to FY 2008**	"
ADD	27863	94	234.1	Over Cedar Ave	Paint		$ 14,930,000	Corridor Planning with TH 94 mill and overlay **2/23/06 Moved to FY 2008**	1/31/2006
ADD	9400	94	257.7	Over St Croix River at Hudson	Paint		$ 14,930,000	**MnDOT's 50% Cost Sharing with WiscDOT – Moved to FY 2010**	

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2008 - FINAL DRAFT (2008 Dollars) -12/02/04 - Revised--8/23/05 - 01/26/06 - 12/06/06 - 03/02/07 - 11/30/07 - 02/29/08

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
						2008 Costs			
1	6738	280	2.3	Under Larpenteur Ave	Removal -- Misc Costs	$ 1,400,000	$ 1,400,000	Replacement funded by BIR Monies. Moved to 2/27/09 Letting. **BIR Funding $2.7 M**	
2	6630	280	2.3	Larp Ave over MC RY	Replacement	$ 2,700,000	$ 4,100,000	Built in 1954 over RR; owned by MnDOT. Moved to 2/27/09 Letting.	
3	9340	35W	18.5	Over Mississippi R	Deck Repair	$ -	$ 4,100,000	Replace O/L and Jts -- LS O/L 1978 -- Costs for Anti-Icing System included -- **TO FY 2007 ($3,000,000)**	
4	9426	52	98.8	SB Over Cannon River	Replace Deck	$ 950,000	$ 5,050,000	Replace deck, no widening planned	
5	9425	52	98.8	NB Over Cannon River	Replace Deck	$ 950,000	$ 6,000,000	Replace deck, no widening planned	
6	19033	52	105.7	SB Over Vermillion River	Deck Repair	$ 180,000	$ 6,180,000	New O/L, Replace Jts -- Type M Jts (1978) --	
7	9488	52	99.1	Under CSAH 88	Deck Repair		$ 6,180,000	Replace O/L, Jts, Rehab Rail and Curb --1981---- **NO DECK WORK RECOMMENDED**	
8	9488	52	99.1	Under CSAH 88	Paint	$ 180,000	$ 6,360,000	40% Unsound ---1964 -- Red Lead --	
9	19842	35	81.8	Under CSAH 70	Replacement	$ 1,000,000	$ 7,360,000	Built in 1965 -- Cost sharing with proposed Dakota County Major Interchange Project	
10	9588	35W	22.9	TH 35W SB Off Ramp overTH 35W NB	Deck Repair	$ 420,000	$ 7,780,000	Conc Box Girder, built 1964: LS O/L 1978; 11,000 SF	
11	9352	35W	23.4	NB TH 35W Over RR-W Fr Rd	Deck Repair	$ 210,000	$ 7,990,000	Replace O/L, Jts; Misc Rehab -- LS O/L 1977 --- 9000 sf. **ADVANCE FROM FY 2009**	
12	9351	35W	23.4	SB TH 35W Over RR-W Fr Rd	Deck Repair	$ 190,000	$ 8,180,000	Replace O/L, Jts; Misc Rehab -- LS O/L 1977 — 9000 sf. -- **ADVANCE FROM FY 2009**	
13	9354	35W	23.5	NB TH 35W Over Cty Rd C	Deck Repair	$ 230,000	$ 8,410,000	Replace O/L, Jts; Misc Rehab -- LS O/L 1977 --- 9700 sf. -- **ADVANCE FROM FY 2209**	
14	9353	35W	23.5	SB TH 35W OverCTY Rd C	Deck Repair	$ 220,000	$ 8,630,000	Replace O/L, Jts; Misc Rehab -- LS O/L 1977 --- 9700 sf. -- **ADVANCE FROM FY 2009**	
15	9569	36	0.1	TH 36 WB over TH 35W	Deck Repair	$ 420,000	$ 9,050,000	**ADVANCE FROM FY 2009**	
16	9276	36	0.3	TH 36 WB over Cleveland Connection	Deck Repair	$ 260,000	$ 9,310,000	**ADVANCE FROM FY 2009**	
17	9277	36	0.3	TH 36 EB over Cleveland Connection	Deck Repair	$ 110,000	$ 9,420,000	**ADVANCE FROM FY 2009**	
18	62029	36	0.8	TH 36 WB over Fairview	Deck Repair	$ 230,000	$ 9,650,000	**ADVANCE FROM FY 2009**	
19	62030	36	0.8	TH 36 EB over Fairview	Deck Repair	$ 130,000	$ 9,780,000	**ADVANCE FROM FY 2009**	
20	5427	36	4.3	Rice St over TH 36	Substructure Repair	$ 100,000	$ 9,880,000	**ADVANCE FROM FY 2009**	

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2008 - FINAL DRAFT (2008 Dollars) -12/02/04 - Revised--8/23/05 - 01/26/06 - 12/06/06 - 03/02/07 - 11/30/07 - 02/29/08

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS	LETTING DATE
21	27009	12	155.4	TH 12 over CSAH 15	Deck Repair	$ 420,000	$ 10,300,000	Corridor Project with SP 2714-139	
22				Various Locations	Bridge Repair	$ 1,400,000	$ 11,700,000	Misc Bridge Repair as needed. (01/26/06) Setaside reduced $1.3 M to $15.0 M	
23	9796	35W	8.9	Under 76th St	Removal -- Misc Costs	$ 1,000,000	$ 12,700,000	Replacement funded by BIR Monies **ADD**	
	27009	12	155.4	Over Cty Rd 15	Paint	$ -	$ 12,700,000	30% Unsound -- 58,700 sf -- 1971 -- Lead Chromate **MOVED TO FY 2006 ($800,000)**	
	27782	94	230.5	Under 7th St N	Partial Paint		$ 12,700,000	50% Unsound - 79,800 sf (3309) - 1981 - Zinc Rich-- **MOVED TO FY 2009 - $380,000**	
	27715	94	230.3	Under Lyndale Ave NB	Partial Paint		$ 12,700,000	30% Unsound - 64,900 sf (3309) -1981 - Zinc Rich--- **MOVED TO FY 2009 - $500,000**	"
	27796	94	230.2	Under Plymouth Ave	Partial Paint		$ 12,700,000	40% Unsound -108,400 sf (3309)-1981 - Zinc Rich -- **MOVED TO FY 2009 - $670,000**	"
	27781	94	230.1	Under 4th St Ramp	Partial Paint		$ 12,700,000	20% Unsound -121,000 sf (3309)- 1981 - Zinc Rich -- **MOVED TO FY 2009 - $1,000,000**	
	9421	94	234.8	Under Riverside Ave	Paint		$ 12,700,000	Corridor Planning ------ Moved from FY 2007 TO FY 2009 --- 40800 SF - Lead - 1973 -- $600,000	
	9420	94	234.7	Under 25th Ave	Paint		$ 12,700,000	Corridor Planning ------ Moved from FY 2007 TO FY 2009 --- 16900 SF - Lead - 1973 -- 270,000	
	9892	94	234.5	Under Ped at 22nd	Paint		$ 12,700,000	Corridor Planning ------ Moved from FY 2007 TO FY 2009 --- 5000 SF -- Lead - 1973 -- $80,000	
	27863	94	234.1	Over Cedar Ave	Paint		$ 12,700,000	Corridor Planning ------ Moved from FY 2007 TO FY 2009 --- 25100 SF -- Lead - 1973 -- $400,000	
24	5895	61	117.6	Over Miss R, RR,Street	Misc Bridge Repair	$ 1,700,000	$ 14,400,000	Mill and Patch Deck, Jt Repair, Conc Repair, Bearing Replacement, Remove Inp Walkway	
25	5895	61	117.6	Over Miss R, RR,Street	Partial Paint	$ -	$ 14,400,000	**HOSP Funded, Est Cost -- $1,200,000.00**	
	9340	35W	18.5	Over Miss R, RR, Street	Steel Retrofit	$ -	$ 14,400,000	Steel Retrofit Project as recommended by CO Bridge **Moved to FY 2009 - $1.5 M**	
26	5462	7	194.2	Over TH 100	Underpinning	$ 600,000	$ 15,000,000	**Emergency Contract**	
							$ -		
							$ -		
							$ -		
							$ -		

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
*FY 2009 FINAL DRAFT(2009) Dollars - 9/22/2005 Revised * 01/26/06 - 02/02/06 - 03/27/06 - 12/05/06 - 03/01/07 - 02/29/08*

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
Move to FY 2011	62044	52	128.8	Under Belvedere St	Deck Repair		$ -	Latex O/L 1974 - Replace with Low Slump O/L. Replace jts, misc concrete Repair -- 6,000 SF **Moved to FY 2011**
1	90381	52	130.2	Under George St	Deck Repair	$ 120,000	$ 120,000	Built 1930: Redecked, Bit O/L 1976. Review Inpl O/L & Jts.- 1,900 SF - LS O/L ???
***	27966	94	232.3	Under Groveland Ave	Deck Repair	$ -	$ 120,000	Built 1965: Limited Service O/L 1991, 2005 GPR 4% Delam; Deck 19,300 SF -- Rdwy 14,800 SF
2	27836	94	232.5	Under Lasalle Ave	Redeck	$ 1,200,000	$ 1,320,000	Built 1964: Limited Service O/L 1991, 2005 GPR 21% Delam; Deck 14,500 SF -- Rdwy 10,300 SF
***	27837	94	232.6	Under Nicollet Ave	Deck Repair	$ -	$ 1,320,000	Built 1966: Low Slump O/L 1980; 12,000 SF
***	27838	94	232.7	Under 1st Ave S	Deck Repair	$ -	$ 1,320,000	Built1965: Low Slump O/L 1982; 8,800 SF
***	27842	94	232.9	Under TH 94 WB On Ramp	Deck Repair	$ -	$ 1,320,000	Conc Box Girder, Built 1966: Limited Service O/L with minimum removals 1996, 15% delam - Rdwy 10,700 SF
***	27840	94	233	TH 94 WB Off Rp to 11th St Under 15th St E	Deck Repair	$ -	$ 1,320,000	Built 1966: Low Slump O/L 1982; Rdwy 10,500 SF
***	27851	94	233.1	Under Portland Ave	Deck Repair	$ -	$ 1,320,000	Built 1967: Limited Service O/L 1994, 2005 GPR 14% Delam; 21,400 SF
***	27852	94	233.2	Under Park Ave	Deck Repair	$ -	$ 1,320,000	Built 1967: Limited Service O/L 1994, 2005 GPR 15% Delam; 19,500 SF
***	27853	94	233.3	Under Chicago Ave	Deck Repair	$ -	$ 1,320,000	Built 1967: Limted Service O/L 1994, 2005 GPR 11% Delam; 18,400 SF
***	27854	94	233.6	Under 11th Ave	Deck Repair	$ -	$ 1,320,000	Built 1965: Low Slump O/L 1982; 20,200 SF
Move to FY 2010	27549A	94	227.4	Under 42nd Ave N (Camden Bridge)	Deck Repair		$ 1,320,000	**PARTNERSHIP PROJECT with City of Mpls ($400,000) Moved to FY 2010**
3	27818	94	229.8	Under TH 94 NB Off Ramp	Partial Paint	$ 140,000	$ 1,460,000	3309 Non-Lead: 22,100 SF; 1981 20%
4	27817	94	229.7	Under TH 94 SB On Ramp	Partial Paint	$ 180,000	$ 1,640,000	3309 Non-Lead: 22,800 SF;1981 20%
5	27815	94	229.6	Under Broadway Ave	Partial Paint	$ 290,000	$ 1,930,000	3309 Non-Lead: 51,000 SF; 1981 25%
6	27814	94	229.2	Under 26th Ave N	Partial Paint	$ 150,000	$ 2,080,000	3309 Non-Lead: 20,900 SF; 1981 25%
Move to FY 2010	27819	94	227.5	Under 41st Ave N	Partial Paint		$ 2,080,000	3309 Non-Lead: 27,000 ESF; 1982 25%
Move to FY 2010	27549A	94	227.4	Under 42nd Ave N (Camden Bridge)	Partial Paint		$ 2,080,000	3306 Non-Lead: 31,000 SF; 1976 30%

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
*FY 2009 FINAL DRAFT(2009) Dollars - 9/22/2005 Revised * 01/26/06 - 02/02/06 - 03/27/06 - 12/05/06 - 03/01/07 - 02/29/08*

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
Move to FY 2010	27821	94	227.3	Under CP Rail	Partial Paint		$ 2,080,000	3309 Non-Lead: 96,000 ESF; 1982 25%
10	82806	694	55.1	TH 694 NB over UP RR	Redeck ----- Replace	$ 1,500,000	$ 3,580,000	Built 1967: Limited Service 1990; Minimum mill and patch 2003, 60% Delam by chaining - Deck - 6300 SF
***	82805	694	55.1	TH 694 SB over UP RR	Redeck ------ Replace	$ -	$ 3,580,000	Built 1967: Limited Service 1990; Minimum mill and patch 2003, 60% Delam by chaining - Deck - 6300 SF
11	82808	694	54.8	TH 694 NB over TH 5	Redeck ------ Replace	$ 2,000,000	$ 5,580,000	Built 1967: LS O/L 1979; Mill and patch 2003 - Deck 9,000 SF
	82807	694	54.8	TH 694 SB over TH 5	Redeck ------ Replace	$ -	$ 5,580,000	Built 1967: LS O/L 1979; Mill and patch 2003 - Deck 9,000 SF
12	2010	10	224.3	Over Main St	Deck Repair	$ 290,000	$ 5,870,000	Built 1964: Low Slump O/L 1982; 11,900 SF
13	9722	10	230.4	TH 10 EB over RR	Redeck ----- Replace	$ 1,700,000	$ 7,570,000	Built 1966: Low Slump O/L 1978; 5,200 SF ------------------- **PARTNERSHIP PROJECT**
14	9721	10	230.4	TH 10 WB over RR	Redeck ------ Replace	$ 1,700,000	$ 9,270,000	Built 1966: Low Slump O/L 1978; 5,200 SF ----------------- **PARTNERSHIP PROJECT**
15	9726	47	12.3	NB TH 47 over CSAH 10	Redeck	$ 700,000	$ 9,970,000	Built 1966: Low Slump O/L 1978 ; 7500 SF -- Let with TH 10 Project. Design Exception approved
16	9725	47	12.3	SB TH 47 over CSAH 10	Redeck	$ 700,000	$ 10,670,000	Built 1966: Low Slump O/L 1978 ; 7500 SF -- Let with TH 10 Project. Design Exception approved
17				At Various Locations	Bridge Repair	$ 2,070,000	$ 12,740,000	Misc Bridge Repair as needed. (01/26/06) Setaside reduced $1.3 M to $15.0 M
FY 2008	9569	36	0.1	TH 36 WB over TH 35W	Deck Repair		$ 12,740,000	Conc Box Girder, Built 1962: Low Slump O/L 1978; 17,400 SF
FY 2008	9276	36	0.3	TH 36 WB over Cleveland Connection	Deck Repair		$ 12,740,000	Built 1962: Low Slump O/L 1982; 6,500 SF ------ 12/05/06 ----
FY 2008	9277	36	0.3	TH 36 EB over Cleveland Connection	Deck Repair		$ 12,740,000	Built 1962: Low Slump O/L 1982, Mill & Patch 2003; 9,900 SF --- 12/05/06 ---
FY 2008	62029	36	0.8	TH 36 WB over Fairview	Deck Repair		$ 12,740,000	Built 1969: Low Slump O/L 1982; 10,800 SF ---- 12/05/06 ---
FY 2008	62030	36	0.8	TH 36 EB over Fairview	Deck Repair		$ 12,740,000	Built 1969: Low Slump O/L 1982; 12,200 SF ---- 12/05/06 ---
FY 2008	5427	36	4.3	Rice St over TH 36	Substruture Repair		$ 12,740,000	Built 1936: Remodeled 1966 --- Needs Shotcrete Work ----- **Corridor Planning**
FY 2008	9588	35W	22.9	TH 35W SB Off Ramp over TH 35W NB	Deck Repair		$ 12,740,000	Conc Box Girder, Built 1964: Low Slump O/L 1978; 11,000 SF

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
*FY 2009 FINAL DRAFT(2009) Dollars - 9/22/2005 Revised * 01/26/06 - 02/02/06 - 03/27/06 - 12/05/06 - 03/01/07 - 02/29/08*

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF. POINT	FEATURED CROSSING/ DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
FY 2008	9351	35W	23.4	TH 35W SB over RR & W Fr Road	Deck Repair		$ 12,740,000	Built 1963: Redecked, Low Slump O/L 1977: 9,000 SF
FY 2008	9352	35W	23.4	TH 35W NB over RR & W Fr Road	Deck Repair		$ 12,740,000	Built 1963: Redecked, Low Slump O/L 1977: 9,000 SF
FY 2008	9353	35W	23.5	TH 35W SB over CR C	Deck Repair		$ 12,740,000	Built 1963: Redecked, Low Slump O/L 1977: 9,700 SF
FY 2008	9354	35W	23.5	TH 35W NB over CR C	Deck Repair		$ 12,740,000	Built 1963: Low Slump O/L 1977: 9700 SF
30* 02/28/07**	9340	35W	18.5	Over Miss R, RR, Street	Steel Retrofit		$ 12,740,000	Steel Retrofit Project may be recommended by CO Bridge. Only "guesstimated" cost available at this time.
18	27782	94	230.5	Under 7th St N	Partial Paint	$ 170,000	$ 12,910,000	**MOVED FROM FY 2008**
19	27715	94	230.3	Under Lyndale Ave NB	Partial Paint	$ 270,000	$ 13,180,000	**MOVED FROM FY 2008**
20	27796	94	230.2	Under Plymouth Ave	Partial Paint	$ 280,000	$ 13,460,000	**MOVED FROM FY 2008**
21	27781	94	230.1	Under 4th St Ramp	Partial Paint	$ 450,000	$ 13,910,000	**MOVED FROM FY 2008**
22	9421	94	234.8	Under Riverside Ave	Paint	$ 460,000	$ 14,370,000	**MOVED FROM FY 2008**
23	9420	94	234.7	Under 25th Ave	Paint	$ 220,000	$ 14,590,000	**MOVED FROM FY 2008**
24	9892	94	234.5	Under Ped at 22nd	Paint	$ 85,000	$ 14,675,000	**MOVED FROM FY 2008**
25	27863	94	234.1	Over Cedar Ave	Paint	$ 325,000	$ 15,000,000	**MOVED FROM FY 2008**

BIP FY 2010

FY 2010 1st Draft — 02/10/06 - Revised —05/16/06 - 8/04/06 — 1/08/07 - 03/02/07 - 02/15/08 - 02/29/08

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF POINT	FEATURED CROSSING DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
1	82805	694	55.1	TH 694 SB over UP RR	Replace	$ 2,300,000	$ 2,300,000	Built 1967: Limited Service 1990; Minimum mill and patch, 60% Delam by chaining. Deck - 6300 SF -- Cost includes temporary widening for Br#'s 82805/06 TC$300,000
2*****	82807	694	54.8	TH 694 SB over TH 5	Replace	$ 2,700,000	$ 5,000,000	Built 1967: LS O/L 1979; Mill and Patch 2003 - Deck - 9,000 SF -- Cost includes temporary widening for Br#'s 82807/08 - TC$300,000
3	9400	94	257.7	WB over St Croix River	Repainting	$ 3,900,000	$ 8,900,000	MnDOT's 50% Cost Sharing with WiscDOT. ------ Scheduled letting by WicsDOT — January 2010.
4	6347	243	1.2	TH 243 over St Croix River	Deck Repair	$ 300,000	$ 9,200,000	Built 1953: Redecked 1980, no O/L; Place LS O/L, new exp jts, rehab s/w and rail, replace bearings. MnDOT's 50% cost sharing with WisscDOT.
5	27003	94	231.6	Whitney Ped over TH 94	Redeck	$ 200,000	$ 9,400,000	Built 1988: Timber deck and wood stair steps. Deck - 4600 SF.
6	9078	494	4.2	Ped over TH 494.	Stair Repair	$ 200,000	$ 9,600,000	Built in 1960. Needs misc stair and deck repair.--**(02/27—Add $100,000)**
7	9077	494	4.4	Nicollet Ave over TH 494	Deck Repair	$ 1,000,000	$ 10,600,000	Built 1959 , 3" LS O/L 1984:-- Redeck --
8	27504	62	110.1	Xerxes Ave over TH 62	Deck Repair	$ 200,000	$ 10,800,000	Built 1962, LS O/L 1976: 7900 SF - 6% Delam ---- Replace O/L & Jts. ---- **Possible Redeck is an additional $750,000.00** ----
9	7268	62	110.5	Penn Ave over TH 62	Deck Repair	$ 200,000	$ 11,000,000	Built 1962, LS O/L 1977: 4% Delam, Replace O/L, 7900 SF, Jts and/or Mill & O/L.
10	7269	62	112.5	Portland over TH 62	Deck Repair	$ 1,100,000	$ 12,100,000	Built 1963: LS O/L 1979: 28% Delam; -- Redeck -- Repaint--**(02/27—Add $300,000)**
11	27549A	94	227.4	Under 42nd Ave N Camden Bridge	Deck Repair	$ 400,000	$ 12,500,000	**PARTNERSHIP PROJECT with City of Mpls**
12*****	27819	94	227.5	Under 41st Ave N	Partial Paint	$ 170,000	$ 12,670,000	3309 Non-Lead: 27,000 ESF, 1982 -- 25% -- **Moved from FY 2009**
13*****	27549A	94	227.4	Under 42nd Ave N Camden Bridge	Partial Paint	$ 200,000	$ 12,870,000	3306 Non-Lead: 31,000 ESF; 1976 -- 25% -- **Moved from FY 2009**
14*****	27821	94	227.3	Under CP Rail	Partial Paint	$ 190,000	$ 13,060,000	3309 Non-Lead: 96,000 ESF; 1982 -- 25% -- **Moved from FY 2009**
15	27808	94	226.5	49th Ave N over TH 94	Partial Paint	$ 120,000	$ 13,180,000	3309 - Non-Lead: 33,100 SF; 1982 20% - (20%)
16	27807	94	225.9	53rd Ave N over TH 94	Partial Paint	$ 100,000	$ 13,280,000	3309 - Non-Lead: 24,700 SF;1981 30% - (20%)
17	27806	94	225.5	57th Ave N over TH 94	Partial Paint	$ 100,000	$ 13,380,000	3309 - Non-Lead: 19,700 SF; 1981 30% - (20%)
18	27805	94	224.9	TH 94 WB over TH 252 SB	Paint	$ 120,000	$ 13,500,000	Non-Lead: 10,100 SF; 1982 20% - (30%)
19	27734	94	224.7	TH 694 EB over TH 94 WB	Partial Paint	$ 120,000	$ 13,620,000	3309 - Non-Lead: 36,100 SF; 1981 25% - (20%)
20	27929	94	224.4	Dupont Ave over TH 94	Partial Paint	$ 200,000	$ 13,820,000	3309 - Non-Lead: 55,000 SF; 1981 30% - (20%)
21	27982	94	224.3	TH 100 NB over TH 94 EB	Partial Paint	$ 120,000	$ 13,940,000	3309 - Non-Lead: 30,200 SF; 1981 40% - (30%)

FY 2010

22	27962	94	224.2	TH 100 SB over TH 94	Partial Paint	$ 550,000	$ 14,490,000	3309 - Non-Lead: 125,100 SF; 1981 60% - (30%)
23	27914	94	224.2	TH 100 NB off ramp/TH 94	Partial Paint	$ 350,000	$ 14,840,000	3309 - Non-Lead: 61,000 SF; 1981 25% - (40%)
24	27913	94	224.2	TH 100 SB on ramp/TH 94	Partial Paint	$ 140,000	$ 14,980,000	3309 - Non-Lead: 30,500 SF; 1981 25% - (30%)
25	27960	94	224.1	TH 694 EB on ramp/TH 94	Partial Paint	$ 120,000	$ 15,100,000	3309 - Non-Lead: 21,900 SF; 1981 10% - (40%)
26	27910	94	223.8	Shingle Creek Prky/TH 94	Partial Paint	$ 150,000	$ 15,250,000	3309 - Non-Lead: 46,300 SF; 1981 30% - (20%)
27	27864	94	223.7	Ped @ Shingle Crk/TH94	Partial Paint	$ 100,000	$ 15,350,000	3309 - Non-Lead: 8,700 SF; 1981 20% - (60%)
Rev 1/08/07	9155	5	64.2	Tunnel under Tower Ave	Tile Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - **Moved to FY 2012**
Rev 1/08/07	27077	5	64.2	Tunnel under Parking Lot	Tile Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - **Moved to FY 2012**
Rev 1/08/07	9300	5	64.3	TH 5 (W 7th) over Miss R	Deck Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
Rev 1/08/07	9489	5	64.4	Under Miss Blvd SB	Deck Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
Rev 1/08/07	9490	5	64.5	Under Miss Blvd NB	Deck Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
Rev 1/08/07	9491	5	64.6	Under Edgcumbe Rd NB	Deck Repair	$ -	$ 15,350,000	TH 5 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
Rev 1/08/07	9538	110	1.3	TH 110 EB over TH 35E	Deck Repair	$ -	$ 15,350,000	TH 110 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
Rev 1/08/07	9537	110	1.3	TH 110 WB over TH 35E	Deck Repair	$ -	$ 15,350,000	TH 110 Corridor Planning - Conc Pvt Repair - Mill and Patch + Jt Rehab - **Moved to FY 2012**
28*****				Various Locations		$ 50,000	$ 15,400,000	Misc Bridge Repair as needed

BIP FY 2011

FY 2011 1st Draft -- 02/22/06 - 2nd Draft --05/23/06 - Rev 02/20/07 - 03/01/07 - 02/29/08

PRIORITY SEQUENCE	BRIDGE NUMBER	T.H.	REF POINT	FEATURED CROSSING / DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
1****	62027	52	130.1	Lafayette over Plato Blvd	Redeck	$ 1,000,000	$ 1,000,000	Corridor planning with Lafayette Bridge Project
2****	62026	52	129.5	Lafayette over Eaton St	Redeck	$ 6,000,000	$ 7,000,000	Corridor planning with Lafayette Bridge Project
3****	62026	52	129.5	Lafayette over Eaton St	Partial Paint	$ 1,000,000	$ 8,000,000	Includes "guesstimate" for access
4	62023	52	129.3	Ped @ Winifred over TH52	Paint	$ 40,000	$ 8,040,000	Crdr plng with Lafayette Br Project - 25% Unsound - 1900 sf - 1969 - Lead
5*	62045	52	129.2	Lafayette over Concord	Deck Repair	$ 290,000	$ 8,330,000	Crdr plng with Lafayette Br Project - Mill & Patch - (Replace Jts) - LS O/L 1992 — 25,600 sf
6	62045	52	129.2	Lafayette over Concord	Paint	$ 500,000	$ 8,830,000	Crdr plng with Lafayette Br Project - 25% Unsound - 36,000 sf - 1975 - Lead
7	62044	52	128.8	Belvedere St over TH 52	Deck Repair	$ 200,000	$ 9,030,000	Crdr plng with Lafayette Br Project - Replace O/L, Jts;Misc rehab -- Latex O/L - 1974 -- 6,000 sf
8	19025	52	128.4	Ped @ Lewis St over TH52	Paint	$ 70,000	$ 9,100,000	Crdr plng with Lafayette Br Project - 25% Unsound - 3,800 sf - 1973 - Lead
9	19021	52	128.1	Butler Ave (CR4) over TH 52	Deck Repair	$ 120,000	$ 9,220,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands- 3-1/2" LS O/L-1985 8,800 sf
10	19018	52	127.3	Thompson Ave (CR6) over TH 52	Deck Repair	$ 90,000	$ 9,310,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L 1992 — 14,300 sf
11	19020	52	127.1	TH 52 NB over Wentworth	Deck Repair	$ 60,000	$ 9,370,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L 1992 --- 5,700 sf
12	19019	52	127.1	TH 52 SB over Wentworth	Deck Repair	$ 60,000	$ 9,430,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L 1992 — 5,700 sf
13	19015	52	126.1	TH 52 SB over South View	Deck Repair	$ 190,000	$ 9,620,000	Crdr plng with Lafayette Br Project - New LS O/L & Jts: Experimental Deck - 1973 --- 6,600 sf
14	19016	52	126.1	TH 52 NB over South View	Deck Repair	$ 100,000	$ 9,720,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L 1992 --- 6,600 sf
15	19856	52	125.4	TH 52 NB over TH 494	Deck Repair	$ 150,000	$ 9,870,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L - 1985 — 22,600 sf
16	19855	52	125.4	TH 52 SB over TH 494	Deck Repair	$ 150,000	$ 10,020,000	Crdr plng with Lafayette Br Project - Mill & Patch - Replace glands - LS O/L - 1985 --- 22,600 sf
FY 2013	6688	61	144.9	TH 61 over BNSF RR	Replace		$ 10,020,000	Built 1952: Structurally Deficient; SR = 43.2 — **BIR Candidate-2013**
18****	27861	94	233.9	TH 94 WB Off Ramp over LRT & City St	Redeck	$ 660,000	$ 10,680,000	Built 1968: Bit O/L Removed - Limited Service O/L 1993; -- Structurally Deficient —— 7000 sf
19	27877	94	234.1	TH 94 WB Off Ramp(5th St) over TH 35W	Deck Repair - Mill & Patch	$ 50,000	$ 10,730,000	Built 1969: 2-1/2" Low Slump O/L - No Removals - 1993;- Est delam 6% - Mill & Patch 10900 sf
20	27062	77	7.6	Old Shaopee Rd over TH77	Deck Repair	$ 450,000	$ 11,180,000	Built 1978: - No LS O/L - New LS O/L, Exp Jts, Rail Repair — 19,900 sf
21		694		Br #'s 82805 - 82806 - 82807 82808	Replace	$ 3,000,000	$ 14,180,000	**ADDITIONAL FUNDING NEEDED FOR "PROJECT WORK" OFF THE BRIDGES**
22				Various Locations		$ 820,000	$ 15,000,000	Misc Bridge Repair as Needed

BIP FY2012

*FY 2012 1st Draft -- 01/24/07 *** Rev 2/21/07 - 3/26/07 - 2/20/08 - 2/29/08*

PRIORITY SEQUENCE	BRIDGE NUMBER	TH	REF POINT	FEATURED CROSSING / DESCRIPTIVE LOCATION	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
1	9538	110	1.3	TH 110 EB over TH 35E	Deck Repair	$ 250,000	$ 250,000	TH 110 Corridor Planning with Conc Pvt Repair
2	9537	110	1.3	TH 110 WB over TH 35E	Deck Repair	$ 210,000	$ 460,000	TH 110 Corridor Planning with Conc Pvt Repair
3	9300	5	64.3	TH 5 (W 7th) over Miss R	Deck Repair	$ 20,000	$ 480,000	TH 5 Corridor Planning with Conc Pvt Repair
4	9489	5	64.4	Under Miss Blvd SB	Deck Repair	$ 10,000	$ 490,000	TH 5 Corridor Planning with Conc Pvt Repair
5	9490	5	64.5	Under Miss Blvd NB	Deck Repair	$ 10,000	$ 500,000	TH 5 Corridor Planning with Conc Pvt Repair
6	9491	5	64.6	Under Edcumbe Rd NB	Deck Repair	$ 30,000	$ 530,000	TH 5 Corridor Planning with Conc Pvt Repair
7	9155	5	64.2	Tunnel under Tower Ave	Tile Repair	$ 10,000	$ 540,000	TH 5 Corridor Planning with Conc Pvt Repair
8	27077	5	64.2	Tunnel under Parking Lot	Tile Repair	$ 50,000	$ 590,000	TH 5 Corridor Planning with Conc Pvt Repair
9	9582	35W	28.7	Under Cty Rd H (Arsenal Entry)	Replace		$ 590,000	Partnership Project with "Possible" Arsenal Development——**NOT APPROVED BY SCOPING COMMITTEE**
10	570	8	11.3	US 8 over Stream	Replace	$ 900,000	$ 1,490,000	US 8 Corridor Planning - Similar structure Br# 13004 cost $860,000.00 in 2005
11	9110	52	117.4	Under TH 55	Deck Repair	$ 370,000	$ 1,860,000	Conc Box Girder built 1958: LS O/L 1976; 9400 SF
12	19078	52	119.6	US 52 SB over UP RR	Deck Repair	$ 80,000	$ 1,940,000	Built 1978: LS O/L 1978; 6000 SF
13	9109	52	119.6	US 52 NB over UP RR	Deck Repair	$ 85,000	$ 2,025,000	Built 1958: LS O/L 1976; 3800 SF
14	19079	52	119.9	US 52 SB over UP RR	Deck Repair	$ 100,000	$ 2,125,000	Built 1978: LS O/L 1978; 6900 SF
15	9108	52	119.9	US 52 NB over UP RR	Deck Repair	$ 50,000	$ 2,175,000	Built 1958: Redecked 1976; 5400 SF -- Galv Rebar -- LS O/L 1976; 4900 SF
16	5427	36	4.3	Under Rice St (Cty 49)	Replace		$ 2,175,000	Conc Rigid Frame: N Span built 1936; S Span built 1966: -- Bit O/L 1985 -- **MOVED TO FY 2013**
17	5715	36	6.4	TH 36 over Keller Lake	Replace	$ 2,100,000	$ 4,275,000	Built 1938; Widened 1968: LS O/L 1999; 8100 SF
18*	4175	Mu3	0.2	Ped over Levee Dr and Minn R in Shakopee	Misc Repair	$ 3,000,000	$ 7,275,000	Rdwy Bridge built in 1927. Designated Ped Br by MOU for TH 169 Br #70002 in 1992
20	9586	35W	28.3	I-35W under US 10WB	Replace	$ 3,800,000	$ 11,075,000	Combine with Br #9585 for **One Project - NEEDS SCOPING -**
	9585	35W	28.5	I-35W under US 10EB	Replace	$ 3,400,000	$ 14,475,000	Combine with Br #9586 for **One Project - NEEDS SCOPING -**
		999		Various Locations		$ 525,000	$ 15,000,000	**Misc Bridge Repair Costs as Needed**
21	6654	5	38.7	TH 5 over Recreation Trail	Replace			Candidate for 2011 BIR Program. FY 2013 BIP MnDOT Matching Funds

22	9053	35W	6.7	W 94th St over I-35W	Replace			Candidate for 2011 BIR Program. FY 2013 BIP MnDOT Matching Funds
	6688	61	144.9	TH 61 over RR	Replace			Candidate for 2011 BIR Program. FY 2013 BIP MnDOT Matching Funds
23	6513	35E	109.3	Under Maryland (CSAH 31)	Replace			Corridor Planning: 2014 Cuyuga Bridge Project.Bridge replacement cost $3.7 M.

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2013 --- 1st Draft - 02/29/08

PRIOR FY	BRIDGE NUMBE	TH	REF POINT	FEATURED CROSSING / DESCRIPTIVE	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
FY 2012	4175	Mu3	0.2	Ped over Levee Dr and Minn R in Shakopee	Superstructure & misc repair			Rdwy Bridge built in 1927. Designated Ped Br by MOU for TH 169 Br #70002 in 1992. --**$3.0 M**
	27568	169	125.537	Over Nine Mile Creek in Hopkins	Beam ends & misc deck repair	$ 1,000,000	$ 1,000,000	Built in 1974, Henn Cty Project. Repair contract in 1995. Beam ends and pier caps need repair.
	27586	169	126.544	Over Excelsior Blvd, 3rd St & RR in Hopkins	Deck, beam end, noise wall repair	$ 470,000	$ 1,470,000	Built in 1978/LS O/L. 3 Active RR tracks remain.
	27587	169	126.971	Over 2nd St in Hopkins	Deck repair	$ 180,000	$ 1,650,000	Built in 1980/LS O/L. Mill & Patch, Jt repair
	4654	36	205.354	Th 36 over St Croix River	Misc repair as directed	$ 2,000,000	$ 3,650,000	Magnitude of Repair dependent on unanswered details.
	6688	61	144.9	TH 61 over BNSF RR	BIR Candidate - MnDOT match	$ 2,000,000	$ 5,650,000	Built in 1952: Limited Service Repair 2003. S.D. with SR of 43.2 -- Bridge cost --- $3.5 M
FY 2014	90446	65	2.856	BNSF RR over TH 65 (Central Ave)	Replace		$ 5,650,000	Built in 1924. Active RR. MnDOT ownership and maintenace responsibility.-- **$7.0 M** --
	9053	35W	6.73	Under W 94th St in Bloomington.	BIR Candidate - MnDOT match	$ 2,000,000	$ 7,650,000	Built in 1957. Limited Service Repair Contract in 1996. S.D. with SR of 48.7-- Bridge cost $3.6 M
	9041	35W	7.26	Under W 90th St in Blooming ton.	LS O/L & misc deck repair	$ 360,000	$ 8,010,000	Built in 1957. Redecked in 1996 without LS O/L.
	9039	35W	7.76	Under W 86th St in Bloomington.	LS O/L & misc deck repair	$ 330,000	$ 8,340,000	Built in 1957. Redecked in 1996 without LS O/L.
	9213	35W	8.25	Under W 82nd St in Bloomington.	LS O/L & misc deck repair	$ 270,000	$ 8,610,000	Built in 1957. Redecked in 1996 without LS O/L.
	9779	13	96.099	TH 13WB over TH 35W in Burnsville	Paint	$ 250,000	$ 8,860,000	Built in 1959. 3305 Steel. Paint in 1975. Facia in 2002. Interior have flaking rust, 40% unsound.
	9780	13	96.099	TH 13EB over TH 35W in Burnsville.	Paint	$ 250,000	$ 9,110,000	Built in 1959. 3305 Steel. Paint in 1975. Facia in 2002. Interior have flaking rust, 35% unsound.
	19893	35E	88.304	I35E SB over Southcross Drive	Deck & Jt Repair	$ 110,000	$ 9,220,000	Built in 1979.*LS O/L. Jt repair
	19809	35E	88.442	I 35 E SB over I 35W	Deck & Jt Repair	$ 350,000	$ 9,570,000	Built in 1964. LS O/L 1980. Jt repair, Abut brngs
	19811	35E	88.815	I 35E SB over CSAH 42	Deck & Jt Repair	$ 115,000	$ 9,685,000	Built in 1978*LS O/L. Jt repair
	19812	35E	88.82	I 35E NB over CSAH 42	Deck & Jt Repair	$ 115,000	$ 9,800,000	Built in 1978*LS O/L. Jt repair
	19889	35E	89.408	Portland Ave over I 35E	Deck & Jt Repair	$ 200,000	$ 10,000,000	Built in 1979.*LS O/L. Jt repair
	19866	35E	89.904	CSAH 38 over I 35E	Deck & Jt Repair	$ 320,000	$ 10,320,000	Built in 1979.*LS O/L. Jt repair

METRO DIVISION
BRIDGE IMPROVEMENT PROGRAM
FY 2013 — 1st Draft - 02/29/08

PRIOR FY	BRIDGE NUMBE	TH	REF POINT	FEATURED CROSSING/ DESCRIPTIVE	WORK TYPE	COST ($)	RUNNING TOTAL ($)	COMMENTS
	19814	35E	90.63	I 35E NB over CSAH 11	Deck & Jt Repair	$ 125,000	$ 10,445,000	Built in 1979.*LS O/L. Jt repair - Beam end repair
	19813	35E	90.638	I 35E SB over CSAH 11	Deck & Jt Repair	$ 125,000	$ 10,570,000	Built in 1979.*LS O/L. Jt repair - Beam end repair
FY 2012	9585	35W	28.47	I-35W under US 10EB	Replace		$ 10,570,000	Combine FY 2012 Funding for Br #9586 and Br #9585 **One Project.**
	5437	36	4.27	TH 36 under Rice St	Replace	$ 3,700,000	$ 14,270,000	Conc Rigid Frame: N Span built 1936 -- S Span built 1966 -- Bit O/L 1985
	6654	5	38.707	TH 5 over Rec Trail in Victoria	BIR Candidate - MnDOT Match			Briidge Cost -- $1.9 M -- **NEEDS SCOPING FOR GRADING COSTS**
		999		Various Locations		$ 730,000	$ 15,000,000	Misc Bridge Repair as Needed

Don Flemming/Minneapolis /URSCorp
04/14/2006 09:45 PM

To Ed Zhou
cc Mark Maves/Minneapolis/URSCorp@URSCORP
bcc
Subject Fw: Bridge 9030 Final Report

I just got this input from Gary this afternoon after talking to him about another issue. I am concerned about a recommendation from URS that would put off work until 2017.

What do you think, I feel we maybe better stay away from a long term delay recommendation.

Don

----- Forwarded by Don Flemming/Minneapolis/URSCorp on 04/14/2006 03:42 PM -----

"Gary Peterson " <Gary.Peterson@dot.state.mn.us>
04/14/2006 03:13 PM

To <Don_Flemming@urscorp.com>
cc "Bob Miller" <Bob.Miller@dot.state.mn.us>, "Daniel Dorgan" <Dan.Dorgan@dot.state.mn.us>, "Paul Kivisto" <Paul.Kivisto@dot.state.mn.us>
Subject Bridge 9030 Final Report

Don, after talking with the district, it looks like we have two improvement options that are being considered that should probably be addressed in your final report.

The first which I think we were on track with was, in the near future, to replace the deck and add deck continuity and also add redundancy to the 8 arch details.

The second option is to overlay the bridge now, and to hold off adding redundancy until it would be redecked in about 2017. (Unless there are be a couple of areas that are of particular concern or that have a history of problems that should dealt with during an overlay project). We may need to closely monitor the critical members during inspections, and have repair concepts developed that can be quickly detailed and installed.

Ed Zhou/HuntValley/URSCorp
06/19/2006 02:11 PM

To Brett McElwain/HuntValley/URSCorp@URSCORP
cc Nick Deros/HuntValley/URSCorp@URSCORP
bcc
Subject Fw: Br. 9340 TH 35W over the Mississippi River investment strategy

----- Forwarded by Ed Zhou/HuntValley/URSCorp on 06/19/2006 02:11 PM -----

Don Flemming/Minneapolis/URSCorp
06/19/2006 12:23 PM

To Ed Zhou
cc Mark Maves/Minneapolis/URSCorp@URSCORP
Subject Fw: Br. 9340 TH 35W over the Mississippi River investment strategy

Ed, we need to get the report done as soon as possible. I feel that I personally and URS in general will loose a lot of credibliity if we do not respond with a report some time before the July 24 th time frame as Gary Peterson discussed in his e-mail. They need recommended repair concepts as soon as we can get them to the DOT well ahead of the Junly 24th date.

Please advise on the latest status on how we meet the DOT's needs and the completion of the report as soon as posible.

Thanks

Don

----- Forwarded by Don Flemming/Minneapolis/URSCorp on 06/19/2006 11:17 AM -----

"Gary Peterson " <Gary.Peterson@dot.state.mn.us>
06/16/2006 09:58 AM

To <Don_Flemming@URSCorp.com>
cc "Daniel Dorgan" <Dan.Dorgan@dot.state.mn.us>, "Scott Pierson" <Scott.Pierson@dot.state.mn.us>
Subject Fwd: Br. 9340 TH 35W over the Mississippi River investment strategy

Don, FYI. See the following. We will have a meeting to discuss these issues on July 24th. As I mentioned in my previous note we need the recommended repair concepts (task 9) to begin discussions with Metro on how we respond once a crack is discovered in the bridge, assuming a contract to add redundancy is delayed 15 years.

>>> Jerome Adams 6/16/2006 7:23 AM >>>
We will meet again to discuss the investment strategy for this bridge. There are two items we need to focus on as we plan the future of this bridge. These items are the concrete deck and the steel structure.

CONCRETE DECK:
The entire deck has been chain dragged for unsound concrete. The Ground Penetrating Radar Survey (GPR) was not completed due to funding. The results of the deck chaining indicate 5% to 7% of the deck are unsound. Based on this information Paul Kivisto's preliminary recommendation is to do a concrete scarify and low slump concrete overlay of the entire bridge deck on SP 2783-107 in 2007. This work will enable the deck to last another 15 years or to about 2022.

STEEL STRUCTURE:
The URS Fatigue Study should be complete by the time we have this meeting. The Bridge Office will have reviewed the report. Based on the results of the report we will need to discuss whether the steel needs reinforcement and when. We will also need to discuss and enact a strategy for dealing with the possibility that a crack may be found in the steel structure between now and 2022. If that occurs how do we handle it. Is it likely it can be fixed? How much money will it cost? Should we budget for this fix every year even if we never use it? What is the likelihood that we may have to close the bridge unexpectedly, and for a very long time?

Lastly, even if we are able to keep the bridge functioning in 2022 we should discuss whether we think the bridge should be redecked and reinforced, or flat out replaced after 2022. If we have a good idea we should begin budgeting for the outcome.

Free Field 1: MNDOT
Free Field 2: Busy
Private Flag: 1

Jerome Adams, P.E.
Senior Engineer
MNDOT
Metro Design
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Roseville, MN 55113
Office: 651-582-1320 Fax: 651-634-2162
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Minnesota Department of Transportation

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Minutes

July 12, 2006
8:30 AM to 9:30 AM
Waters Edge Conf. Rm. 148
Subject: Br. 9340 TH 35W over the Mississippi River investment strategy
Attendees:

Jerome Adams, Meeting chair/recorder	Dale Dombroske – Metro Maintenance
Paul Kivisto – Oakdale Bridge	Gary Peterson – Oakdale Bridge
Geoff Prelgo – Metro Design	Mark Pribula – Metro Bridge Maintenance
Roger Schultz – Metro Bridge Maintenance	

1.0 Br. 9340 Fatigue Study Briefing

Gary and Paul summarized the Draft Final Report of the Br. 9340 Fatigue Study by URS. In general, the report says that the structure is sound with a low risk of structural failure. To further reduce the risk of failure the report recommends structural steel reinforcement and a new concrete bridge deck.

2.0 Base 15 year bridge investment strategy

It now seems certain that the BASE investment strategy for Bridge 9340 over the next 15 years will be the following. I call it the BASE investment strategy, because this represents the bare minimum that would occur. See the following sections for additional considerations and work.

2.1 2007: On SP 2783-107 a 2" concrete deck scarify with 2" low slump concrete deck overlay including some full depth deck patching at a cost of $3.5 million. This will extend the life of the bridge to the year 2022.

2.2 2012: If it is decided to replace the entire bridge in 2022, then that decision must be made in the year 2012. This allows 10 years for Mn/DOT to program funds and develop this complex project. If the decision is to redeck the bridge in 2022, then that decision can be made in 2017.

2.3 2017: Make final decision to redeck the bridge in 2022 at a cost of $13 million. This gives 5 years to program the funds and develop the project.

2.4 2022: Either redeck the bridge or replace the bridge.

3.0 Structural steel reinforcement

The URS report recommends that high tensile strength steel plates be bolted onto 20 of the steel members on the bridge. These 20 members are the most at risk of failure due to the loading they endure. This work will further reduce the risk of a structural steel failure. A rough estimate for this work is $2 million dollars.

4.0 What does "low risk of structural failure" mean?

The URS report says that the bridge is sound. But we also know that the bridge is Fracture Critical, which means that there are no redundant spans that will keep the bridge standing if the other span should fail. So what are the chances that one of the spans will fail?

The URS report says that the risk is low. Well, what does that mean? We know that the bridge was built in the 1960's. This means that the grade of the steel and the construction techniques for assembling the steel do not meet the standards that we would require today. The bridge engineers then conclude that it is a real possibility that a crack could form that will cause a steel member to fail. The URS report just says that this risk is low.

5.0 What's the implication of a steel member failing due to a crack?

The bridge must be closed to all traffic. This means that Interstate 35W will be completely closed in both directions at the Mississippi River.

The URS report makes Mn/DOT engineers feel even better that we would be able to find a crack in a steel member with annual or even semi-annual inspections before the member itself fails. Therefore, we are not worried the bridge will collapse. But at the same time if a crack is found Mn/DOT will close the bridge until the situation is resolved.

6.0 What's the resolution to finding a crack on the bridge?

Hopefully, the resolution is to reinforce the failed member. A more severe possibility is that we have to reinforce many members, or more than that we may have to reinforce all 20 members recommended in the URS report.

At the very worst the failure could be of such a state that Mn/DOT condemns the bridge permanently. Then the only solution is a new bridge.

7.0 Winter weather and choosing when to reinforce the bridge.

As stated before Mn/DOT is confident that the bridge is sound and that we can spot a crack before the structural integrity of the bridge is compromised. However, if a crack forms it is most likely going to form in the winter when the cold weather makes the steel even more brittle. Therefore, its most likely that the bridge will be closed and the crack repair prosecuted in the winter. Since the bridge is over the Mississippi River, how do you get the new steel to the broken member. Will the river be frozen, so that you can't float a crane barge up the river? Will subzero temperatures make performing the work next to impossible? The bottom line is that weather will dictate how and when the work is prosecuted instead of Mn/DOT choosing the terms of the work prosecution.

8.0 Ordering reinforcing steel

The steel needed to reinforce the bridge is a special high tensile steel. This steel needs to be ordered from overseas. The order will take 3 to 4 months to fill. If we wait until a crack occurs and then order the steel then it will take 3 to 4 months just for the steel to arrive, and the bridge will be closed for that entire time.

9.0 Steel Reinforcement Options

Based on the information above we arrive at the following options.

9.1 Inspect steel and do not order steel reinforcement

9.1.1 Benefit: Don't have to pay for steel, stockpile steel, or install steel.

9.1.2 Risk: If a crack is found it will take 4 months to order steel and reinforce the bridge, and the bridge will be closed to traffic for this duration.

9.2 Inspect steel, order and stockpile steel reinforcement

9.2.1 Benefit: Purchase price of steel will be cheaper now than in the future. Steel will be on hand for immediate use for an emergency repair. Do not have spend the money to actually install the steel right now.

9.2.2 Risk: Crack is most likely to form in the winter when working conditions are tough at best. Bridge will be closed until the work is complete. Bad winter whether may delay the fix.

9.3 Install reinforcement steel right now.

9.3.1 Benefit: Risk of a crack forming between now and 2022 is greatly reduced. Mn/DOT gets to choose the ideal time and circumstances for prosecuting the work.

9.3.2 Risk: Non, but must pay 2 million dollars to get the job done.

10.0 Next Steps

Bridge office will develop costs for the various options listed above and present them to Metro in September 2006. At that time Metro and the Bridge Office will work together to develop the preferred alternative and pursue the programming of the work.

UNIVERSITY OF MINNESOTA

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FY98-PCi-001
PCILET02

December 21, 1998

Mr. Donald J. Flemming
State Bridge Engineer
Offices of Bridges and Structures – Mn/DOT
Mail Stop 610 – Waters Edge Building
1500 West County Road B2
Roseville, MN 55113

Re: Bridge No. 9340 - Load Test Results

Dear Mr. Flemming:

The intent of this letter is to give you a brief synopsis of the load tests conducted on Bridge No. 9340 and a recommendation from the University of Minnesota concerning repositioning the diaphragms. The South Approach Span on the northbound side of Bridge No. 9340 was instrumented at two locations with strain gages. Both locations were just north of Pier 3 on Girder 2 and Girder 6, in the region where diaphragms frame in to the plate girders. Strain gages were placed to determine if lowering the diaphragms and reducing the rigidity of the diaphragm connection would reduce the stress in the web of the plate girder. Strain data were collected when trucks with a known weight were driven over the bridge prior to the diaphragm being lowered and after the diaphragms were lowered. A memo from the Office of Bridges and Structures dated November 17, 1998 to Gary Workman, Attachment A, discusses the instrumentation locations, truck test locations, and procedures for lowering the diaphragms.

Instrumentation

Prior to any work related to lowering the diaphragms (rivet removal and hole drilling in the stiffeners) six strain gages were affixed at each location. Four of the six strain gages were attached to the web plate as close as possible to the toe of the tension flange/web weld near the diaphragm connection plate. The gages were orientated in a vertical direction (transverse to the direction of the girder). Two strain gages were attached on each side of the web with one strain gage on each side of the stiffener. The other two strain gages were located on the compression flange. The purpose of these gages was to correlate the pre-diaphragm lowering truck test data with the post-diaphragm lowering truck test data. At the Girder 2 location, an additional four gages were attached to the web and tension flange to determine the torsional stresses and the neutral axis location in the girder due to the rigid diaphragm connection. A portable PC based data acquisition system capable of simultaneously reading 12 strain gages was used to collect the strain data.

Truck Tests Procedure

Two load tests were conducted on Bridge 9340; the first load test was performed prior to removing the rivets and lowering the diaphragms and the second load test was performed after the diaphragms were lowered. (Four bolts were used at each connection and placed in a snug tight condition). The same procedure was used for each load test. Three Mn/DOT Tandem-Axle Dump Trucks, each with a gross vehicle weight of 50,000 pounds, were used. For the first load test, the trucks trailed each other by about 5-10 seconds. In the second load test the follow time between trucks varied from 20-35 seconds. The first set of passes over the bridge was in the east outside lane directly over Girder 2 and is refereed to as Load Position 1. The second set of truck passes was in the east inside lane and is refereed to as Load Position 2. The third set of truck passes was in the west inside lane and is refereed to as Load Position 3. The fourth set of truck passes was in the west outside lane directly over Girder 6 and is refereed to as Load Position 4.

Results – Girder 2

No data from Load Position 1, Load Position 3, and Load Position 4 are shown for Girder 2, because the maximum stresses developed in the web of Girder 2 as a result of the load tests occurred during Load Position 2 (trucks in east inside lane). Figure 1 contains four charts which show stress (ksi) versus time (seconds) in the girder web and compression flange prior to lowering the diaphragms for Load Position 2. The upper left chart is a comparison of all six strain gages. The upper right chart contains the flange strain data, the lower left chart contains web strain data for the web on the west side, and the lower right chart contains web strain data on the east side of the web. In a like manner, Figure 2 contains the results for Load Position 2 after the diaphragms were released and lowered. Stress values were calculated from the strain gage data collected during the load tests.

Prior to releasing and lowering the diaphragms, the web of Girder 2 near the diaphragm connection plate is bending around the flange, as one would expect. The west side of the web is in tension with a peak value about 1 ksi and the east side of the web is in compression with a peak value about 1 ksi. After the diaphragms were lowered, the stress in the web was almost completely eliminated, with a peak value less than 0.2 ksi. The flange stress and response in both load tests are almost the same, indicating that lowering the diaphragms has not changed the distribution of load among girders or the torsion.

Results – Girder 6

The maximum stresses developed in the web of Girder 6 during the load tests occurred while the trucks were in Load Position 3 (trucks in the west inside lane). As a result, no data from Load Position 1, Load Position 2, and Load Position 4 are shown for Girder 6. Using the same chart layout as explained above, Figure 3 contains the results prior to lowering the diaphragms for Load Position 3 and Figure 4 contains the results for Load Position 3 after the diaphragms were released and lowered.

This section did not behave as expected. Prior to lowering the diaphragms the west side of the web shows a tensile stress of approximately 3 ksi the east side of the web shows a tensile stress of about 2 ksi. One can conclude that the web has a net tensile stress of about 2.5 ksi along with a bending stress of approximately 0.5 ksi. After the diaphragms were released and lowered, the stress on the west side was tensile with a magnitude of approximately 1.2 ksi and on the east side the stress was compressive with a magnitude of about 0.6 ksi. Again this section has a net tensile stress along with a bending component, although the magnitudes are reduced substantially. Similar to Girder 2, the flange stress and response in both load tests are almost the same, indicating that lowering the diaphragms has not changed the distribution of load among girders or the torsion.

Conclusion

The decrease in stress in the affected areas, a factor of over two for Girder 6 and considerably more for Girder 2, should be sufficient to preclude any further cracking in the web. Therefore, on Bridge No. 9340, the University of Minnesota recommends repositioning the diaphragms and decreasing the rigidity of the diaphragm-stiffener connection at other affected locations on the bridge.

If you have any questions, please call me at (612) 626-1823.

Sincerely,

Paul M Bergson

Paul Bergson, PE
Research Fellow

Enclosures (2)

cc: Professor Robert Dexter - UM
Professor Carol Shield - UM
Gary Peterson – Mn/DOT
Paul Kivisto – Mn/DOT
Arlen Ottman – Mn/DOT
Mr. Tom Sloan

Recommendations on Truss Members Retrofit

The following table lists the identified 13 fracture critical truss members on one half of each truss. Due to the double symmetry of the deck truss, there are a total of 52 fracture critical main truss members on the bridge structure. Figure 1 shows all the fracture critical members on one truss, or 26 members. These include the corresponding chord members on the opposing side of the zero-force vertical from the fracture critical members identified by the redundancy analysis.

Table. Infinite Fatigue Life Check of Fracture Critical Members on One Half of Each Truss

Truss Member	Dead Load Axial Stress	*Fatigue Guide Specs* Fatigue Truck Method				*LRFR Manual* Fatigue Truck Method			
		LL+I Stress Range S_r I = 10%	Factored Stress Range R_sS_r	Limiting Stress Range S_{FL} Cat. D	Limiting Stress Range S_{FL} Cat. E	LL+I Stress Range Δf I = 15%	Max Stress Range Factored $2.0R_s\Delta f$	Fatigue Threshold $(\Delta f)_{th}$ Cat. D	Fatigue Threshold $(\Delta f)_{th}$ Cat. E
	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)	(ksi)
L1-L2	1.50	1.53	2.58	2.60	1.60	1.63	3.10	7.00	4.50
L2-L3	1.50	1.42	2.38	2.60	1.60	1.51	2.86	7.00	4.50
U0-U1	9.76	1.19	2.00	2.60	1.60	1.30	2.48	7.00	4.50
U1-U2	8.54	0.68	1.15	2.60	1.60	0.74	1.41	7.00	4.50
U4-U5	11.61	1.17	1.97	2.60	1.60	1.25	2.37	7.00	4.50
U5-U6	10.95	1.16	1.95	2.60	1.60	1.24	2.35	7.00	4.50
L11-L12	15.73	0.71	1.20	2.60	1.60	0.75	1.42	7.00	4.50
L12-L13	15.73	0.71	1.19	2.60	1.60	0.75	1.42	7.00	4.50
L13-L14	17.54	0.58	0.97	2.60	1.60	0.61	1.16	7.00	4.50
U6-U7	18.06	0.38	0.65	2.60	1.60	0.41	0.78	7.00	4.50
U7-U8	18.58	0.43	0.73	2.60	1.60	0.46	0.88	7.00	4.50
U8-U9	17.45	0.36	0.61	2.60	1.60	0.39	0.74	7.00	4.50
U9-U10	17.33	0.34	0.58	2.60	1.60	0.36	0.69	7.00	4.50

The table also summarizes AASHTO criteria for infinite fatigue life check in accordance with the Fatigue Guide Specifications and the LRFR Manual using the fatigue truck method. The Fatigue Guide Specifications is more conservative than the LRFR Manual in that it applies a 1.75 reliability factor (vs. 1.0 in LRFR) to the calculated stress range due to the fatigue truck for fracture critical members and uses an infinite fatigue life limiting stress range of 0.367 times (vs. 0.5 times in LRFR) the constant amplitude fatigue threshold developed from fatigue tests. As shown in the table, all members satisfy the LRFR requirements for infinite fatigue life although the first six members fail to satisfy the Fatigue Guide Specifications for the Category E fatigue detail (U1-U2 is included in this group because of its counterpart U0-U1).

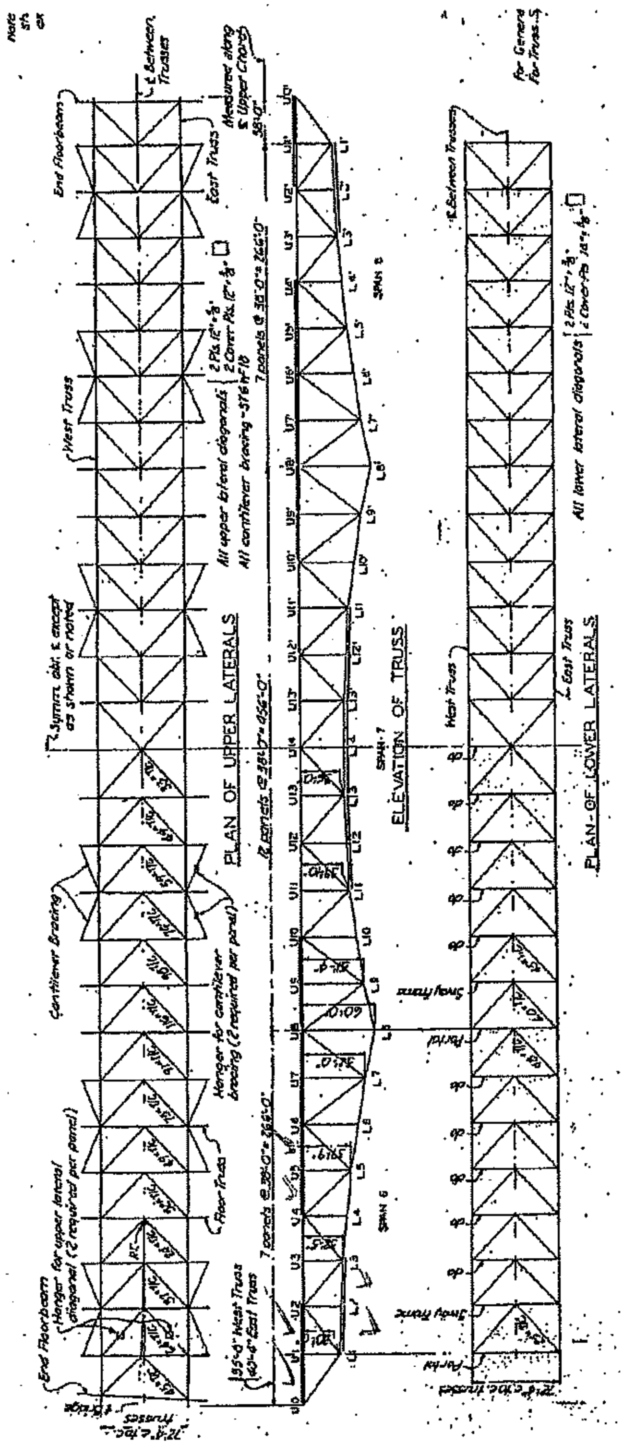

Figure 1: Deck Truss Framing Plan and Elevation from Original Contract Plans (Highlighted Members are Identified Fracture Critical Members)

The fracture critical members can be divided into two general groups: (1) relatively more fatigue sensitive members (L1-L2, L2-L3, U0-U1, U1-U2, U4-U5, and U5-U6), these members are subject to higher fatigue load stress ranges, not satisfying the Fatigue Guide Specifications' infinite fatigue life check for Category E, but are subjected to lower total stresses and have thinner web plates that are more forgiving for brittle fracture; and (2) relatively more fracture sensitive members (L11-L12, L12-L13, L13-L14, U6-U7, U7-U8, U8-U9, and U9-U10), these members have larger cross sections and are subject to very low fatigue load stress ranges, satisfying all AASHTO infinite fatigue life checks for Category E, but are subjected to higher total stresses and have thicker web plates that do not tolerate the existence of through-thickness cracks before the occurrence of brittle fracture.

It is very important to emphasize that neither a fatigue crack would propagate under repeated fluctuating load nor a brittle fracture would occur under some heavy load without a preexisting flaw or crack. As the results of a fracture mechanics analysis indicated in Section 9, the dimensions of preexisting cracks need to be quite large in order to propagate under the traffic load and grow to a critical size to induce a brittle fracture of the truss chord web plate. Since the locations of fatigue susceptible details are clearly known on Bridge 9340, one alternative retrofit approach to steel plating is to perform an in-depth non-destructive examination (NDE) of all the suspected details for existing cracks and flaws. For any weld-induced flaws or cracks discovered by the NDE efforts, a suitable procedure (e.g. grinding) should be carried out to remove the sources of localized stress concentration. After all the fracture critical members are assured of no existence of measurable cracks or flaws, confidence should be obtained for these members for infinite fatigue life under the traffic load.

Based on the analysis results described in this report, three equally viable retrofit approaches are recommended as follows:

(1) Steel plating of all 52 fracture critical truss members. This approach will provide member redundancy to each of the identified fracture critical members via additional plates bolted to the existing webs. The critical issue of this approach is to ensure that no new defects

are introduced to the existing web plates through the drilled holes. This approach is generally most conservative but its relatively high cost may not be justified by the actual levels of stresses the structure experiences.

(2) Non-destructive examination (NDE) and removal of all measurable defects at suspected weld details of all 52 fracture critical truss members. The critical issue of this approach is to ensure that no measurable defects are missed by the NDE efforts. The fracture mechanics analysis has indicated that the dimensions of preexisting surface cracks need to be at least one quarter of the web plate thickness in order to grow and subsequently cause member fracture under the traffic load. This approach is most cost efficient.

(3) A combination of the above two approaches: steel plating of the 24 more fatigue sensitive members (L1-L2, L2-L3, U0-U1, U1-U2, U4-U5, and U5-U6 in each half of each truss), and NDE of the 28 more fracture sensitive members (L11-L12, L12-L13, L13-L14, U6-U7, U7-U8, U8-U9, and U9-U10 in each half of each truss).

From: Gary Peterson **Sent:** Fri, 09 Feb 2007 12:07:35 GMT

To: Bob Miller

CC: Daniel Dorgan; Todd Niemann; Kevin Western;

Subject: URS proposal to assist on 9340

Bob, I reviewed the URS proposal and have the following comments:

Our Bridge inspections Unit will work with Metro this spring to inspect the identified critical members that are located under the south end of the truss and will do visual inspection of all tab plate welds and will do some ultrasonic inspection particularly if their visual inspection finds a flaw or is incomplete. If no flaws are detected and if time permits they will move on to critical members located in other spans or will return later in the year to continue their inspection. Due to the amount of work involved, its very likely all critical members will not be inspected this year, but that inspection should be complete sometime next year.

I anticipate that if flaws are found we may request some analysis by URS, but will very likely remove the flaw either by drilling or grinding either during the inspection, or shortly thereafter. I don't think its necessary, or that we would want URS on site during the inspection since their presence would not add value to the inspection process. The 136 hours for Inspection Assistance they tabulate should be reduced to about 40 hrs to analyze the significance of cracks detected during the inspections over the next two years.

I don't believe we should have them start developing plans or special provisions until we determine during our inspections that a project is likely. We might determine a project is warranted if our inspection finds flaws that cant be repaired or finds that we are unable to inspect or detect flaws. If we determine we are confident that our inspections can find all critically sized flaws, I don't think we will end up recommending a project. We should be able to make that determination after inspections are at least partially completed this fall.

Metro has postponed the 2008 project. I've asked them to identify repair work they can cancel to fit a plating contract into 2009 if we determine to move ahead with a plating project.

If we want a little bit of additional assurance, we could have URS contract with the NDT firm they have talked to us about. The process they use is to place sensors around places they would expect cracks to form and listen for cracking indications. We have copies of three of their reports they have provided us. If that testing were done on a couple of the highest stressed or high fatigue stress details we "may" be able to tell if a small flaw is growing but is not viable. Still, according to the URS report unless a critically sized flaw is found it has no growth mechanism. Without a growth mechanism we may not actually find anything with this testing.

All in all, I think the services proposed will not be needed, but if we can contract for them on a contingency basis, a supplement may be worth writing.

2783-107 Precon Invite List

Mn/DOT		**e-mail**	**phone**
Assistant District Engineer, Construction	Terry Zoller	☑	☐
Resident Engineer	Liz Benjamin	☑	☐
Project Engineers	Eric Embacher	☑	☐
Project Supervisor	Barry Nelson	☑	☐
Inspector	Mark LeMay	☑	☐
Inspector	Harvey Unruh	☑	☐
Surveying	Steve Sorgenfrei	☑	☐
Public Affairs	Beth Petrowske	☑	☐
Materials Inspection	Metro Materials Precon	☑	☐
Utilities Office	Curt Fakler	☑	☐
Utilities Office	Manny Taye	☑	☐
Traffic Office	metroteprecon	☑	☐
Maintenance	Bev Farraher	☑	☐
Concrete Office	Ron Mulvaney	☑	☐
Environmental Services	Karlene French	☑	☐
TMC	Wayne Pankow	☑	☐
EEO	Hope Jensen	☑	☐
Design	Chris Bosak	☑	☐
Safety Office	Julie Bottolfson	☑	☐
Bridge	Paul Kivisto	☑	☐
Area Manager	Tom O'Keefe	☑	☐
Area Engineer	John Griffith	☑	☐
Contractor			
PCI	Ron Gibbons	☐	☑ by letter & phone
Subcontractors	by PCI		
Utilities			
Others			
Minneapolis-Doug Maday doug.maday@ci.minneapolis.mn.us		☑	☐ 612-673-5750
Hennepin Co.- Eric Drager eric.drager@co.hennepin.mn.us		☑	☐ 612-596-0309
Peer Engineering – Ken Larsen klarsen@peerengineering.com		☑	☐
State Patrol-Capt Dave Graham		☐	☑ 763-591-4672
State Patrol- Lt. Steve Lubbert		☐	☑ 763-591-4679
Admin. Asst.	Nancy Olson-Sperle	☑	☐

ATTENDANCE RECORD

DATE: 6/6/07 TIME: 1:00 pm MODERATOR: E. Embacher

SUBJECT: S.P. 2783-107 PCI

NAME/REPRESENTING	TO RECEIVE A COPY OF THE MINUTES, PLEASE INCLUDE COMPLETE MAILING ADDRESS	TELEPHONE
Eric Embacher / MnDOT	2229 Pilot Knob Rd Mendota Hts	cell 651-775-1158 651-406-4725
Darryl Doughty Timme	PO Box 200 Endeavor WI 53930	608-587-2765
Ken Larsen / Peer Engineering	7615 Golden Triangle Drive, Ste. N Eden Prairie, MN 55344	952-831-3341
TODD M. LANTTO " "	" "	" "
STEVE WESTON PCI		763-350-3539
Tom Sloan	2	612. 940- 0397
STEVE LUBBERT	STATE PATROL 5141 LAKELAND AVE, CRYSTAL 55429	763-591-4679
DANIEL E. BALLING	Killmer Elect.	763-425-2525
SEVERT HESCH	Killmer Elec.	612-363-5143
David Tiegs	Midwest Land Surveyors	763-712-9099
DALE NELSON	MNDOT	651 779-1050
Scott Hansen	MnDOT Traffic Management System	651-234-7982
Bill Olson	MNDOT Maintenance Camden Truckstation	612-520-3560
Helen Baker	14369 93rd ave no Maple Grove mn 55369 Golden Valley Transfer	763 420 6760
BARRY NELSON	2229 PILOT KNOB RD. MENDOTA HTS	651-406-4725
Brad Schmidtbauer	North Valley Inc.	(763) 274-2580
Ron MULVANEY	MnDOT MATERIALS	651-366-5575
JEFF MORBY	MN/DOT TRAFFIC	651-775-3310
Randy Kline	Boschung American	724-681-3568
RAE TRESSLER	2229 PILOT KNOB RD. MENDOTA HGHTS	651 775-1160

ATTENDANCE RECORD

DATE: 6/6/07 TIME: 1:00 pm MODERATOR: E. Embacher

SUBJECT: S.P. 2783-107 PCI

NAME/REPRESENTING	TO RECEIVE A COPY OF THE MINUTES, PLEASE INCLUDE COMPLETE MAILING ADDRESS	TELEPHONE
Beth Petrowske / MnDOT	1500 W. County Rd. B Roseville, MN ? 55	651-234-7508
Mark LeMay	Mn DOT	651 775-1175
MICHAEL N. SCHERBER	HENNEPIN CTY. 1600 PRAIRIE DR MEDINA MN 55340	612-596-0308
Tiffany Kautz / Mn/DOT-Design	1500 W. Cty Rd B2 Roseville, MN 55113	651/234-7641
Tim SINCLAIR	1500 W. CTY Rd B2 ROSEVILLE MN. 55113	(651) 234-7354
Alex Govrik Mn/DOT Lighting	1500 W Cty Rd. B2 Roseville, MN 55113	651-775-9495
Paul Babin MN/DOT Lighting	"	651-755-8697
Emmanuel Taye MN/DOT	"	651-234-7363
Ken Lockaton Boschung Amer.	930 CASS ST. New Castle, Pa. 16101	724-510-8059
Tim Imholte PCI		612-803-5383
MARK Jensen Highway Technologies	4700 Lyndale Ave N. Mpls. MN	(c) 612-383-3940 612-521-4200
Doug Maday Mpls TRAFFIC	doug.maday@ ci.minneapolis.mn.us	612 673 5755 612 221 5274
BRAD ESTOCHEN MNDOT		651-234-7924
Rick Conway PCI		612-875-9023

Ed Zhou/HuntValley/URSCorp
02/27/2006 06:33 PM

To Brett McElwain/HuntValley/URSCorp@URSCORP
cc
bcc
Subject Fw: Bridge 9340 Preliminary Recommendations

----- Forwarded by Ed Zhou/HuntValley/URSCorp on 02/27/2006 01:32 PM -----

Don Flemming/Minneapolis/URSCorp
02/27/2006 01:00 PM

To Ed Zhou
cc Mark Maves/Minneapolis/URSCorp@URSCORP, David Long/Minneapolis/URSCorp@URSCORP
Subject Bridge 9340 Preliminary Recommendations

Ed, Gary Peterson of Mn/DOT called on Friday and I talked to Gary today about the BR. 9340 project. The District is planning work for the bridge and Gary is concerned that they are planning for deck and joint repairs without considering recommendations for a more permanent repair. I told Gary that personally I would defer the proposed deck work and plan for a deck replacement and strengthening project.

Gary would like our preliminary recommendations in the form of a letter next week if possible. I told Gary that we would try to get him a letter next week.

Don

From: Gary Peterson **Sent:** Tue, 07 Nov 2006 17:19:10 GMT

To: Daniel Dorgan

CC: Kevin Western

Subject: Fwd: Fw: RFP for a monitoring system

Bridge 9340 Steel Crack Monitoring.pdf (2076381Kb) **Bridge 9340 Steel Crack Monitoring.doc** (3046912Kb)

Dan, I did review this briefly and discussed with Kevin.
First URS needs to address if the bolted fix is less risky than doing nothing. We still have some questions about if drilling all those holes in the truss box members and terminating the plates at the gusset won't somehow make things worse. If they respond that plating will do no harm and they continue to recommend within the report we should do the plating now, I tend to think we should do the plating and have them prepare plans and specs. It settles things and gives us the greatest security.

If we go to the monitoring plan, we do not follow their recommendation, and we take on a lot of responsibility and cost for monitoring the bridge for the next 15 - 20 years.

If they no longer feel that the bolted repairs should be done, and may add risk to the bridge, then I would agree a monitoring system may be the next best belt and suspenders, recognizing their analysis shows the chance of failure is remote, but the consequence could be high.

>>> <Don_Flemming@urscorp.com> 11/7/2006 12:01 PM >>>

Dan,as we discussed today, Ed and I have been discussing the feasibility of placing a monitoring system on Bridge 9340 to detect any crack on the critical members that may occur. The idea would be to possibly place a monitoring system in lieu of adding the plates. Ed advised that he feels a level of confidence in some of the acoustic systems.

As we discussed we need to modify the RFP approach as shown in Ed's e-mail to be a less formal approach where we just contact selected vendors and get two or three of the most promising systems identified with a system definition and cost.

Please advised with any further concerns and we will wait to here back from you before making any contacts with vendors. We would be happy to advise as to which vendors we would contact prior to any contacts being made if you would prefer that approach.

Thank you for your assistance.

Don

----- Forwarded by Don Flemming/Minneapolis/URSCorp on 11/07/2006 11:35 AM -----

Ed
Zhou/HuntValley/U
RSCorp To
Don
11/07/2006 10:08 Flemming/Minneapolis/URSCorp@URSCor
AM p
cc

Subject
RFP for a monitoring system

Don,

I made some editorial revisions and attached both the Word and PDF versions. It may be better to have all three of them, Dan, Gary and Kevin to take a look at it.

Ed

(See attached file: Bridge 9340 Steel Crack Monitoring.pdf)(See attached file: Bridge 9340 Steel Crack Monitoring.doc)

URS

March 24, 2006

Mr. Gary Peterson, PE
Bridge Office
3485 Hadley Avenue North
Oakdale, MN 55128-3307

RE: Bridge 9340

Dear Mr. Peterson:

Our preliminary recommendations for Bridge 9340 are as described below:

We have used a 3-D computer model, calibrated with field testing results, to identify fracture critical truss members and to study retrofit schemes for improving bridge safety and performance. The bridge safety and performance can be improved if the identified fracture critical members are retrofitted. The bridge redundancy can be also improved if the bridge deck is replaced with a fully continuous deck. The member retrofit and a continuous deck will increase structural redundancy of the bridge system and reduce live load-induced tension stresses in truss members that contain fatigue susceptible details. Our analysis results and recommendations are summarized as follows:

Retrofit of Fracture Critical Truss Members

Eight critical main truss members were selected from one half of each truss for the investigation of structural redundancy and retrofit need. The eight members actually represent thirty-two main truss members due to the nearly double symmetry of the trusses.

The selection of the eight truss members was based on the following criteria:

- Subject to tension under combined dead load and live load
- Containing the fatigue susceptible welded details at the interior diaphragm
- Subject to the highest magnitude of fatigue load stress range

The eight truss members selected based on these criteria are: L3-U4, L1-L2, U0-U1, U4-U5, U3-U4, L4-L5, L12-L13, and L13-L14. A redundancy analysis was performed to evaluate the structural consequence for the sudden failure of each of the eight members. Depending on the load case being considered, it was found that each of the eight members can be fracture critical, i.e., whose failure would result in the failure of at least one other main truss member or connection and thus cause instability of the structural system.

We recommend up to thirty-two main truss members represented by the eight fracture critical members be retrofitted with the steel plating scheme we have developed. The retrofit adds internal redundancy to the member and eliminates the possibility of a member fracture due to the fatigue of the poor welded details at the internal diaphragms. The retrofit also reduces live load stresses at the welded details.

Bridge Retrofit with a Complete Deck Replacement

The existing reinforced concrete bridge deck has a total of seven transverse expansion joints in the truss spans: one at each end of the truss cantilevers, one at the center of each of the three spans, and one at each pier of the center span. Additionally, there is a longitudinal deck joint along the bridge centerline, under the median barriers.

R Del

By making the entire bridge deck continuous throughout, our computer analyses have revealed that live load stress ranges decrease approximately 20% in truss members that contain the fatigue susceptible welded detail at the internal diaphragm. Additionally, we have also found that a continuous deck improves the structural redundancy of the bridge.

In summary, the steel plating retrofit of the identified fracture critical members, and/or a continuous deck will improve the safety and performance of the deck truss system.

We are in the process of completing our study and the final report. Please feel free to contact us for any further questions or concerns.

Sincerely,

URS

Donald J. Flemming

Donald J. Flemming, PE
Project Manager

cc: Ed Zhou / Hunt Valley

Bridge 9340
Preliminary Recommendations for Retrofit Actions

We have used a 3-D computer model, calibrated with field testing results, to identify fracture critical truss members and to study retrofit schemes for improving bridge safety and performance. The bridge safety and performance can be improved if the identified fracture critical members are retrofitted and the bridge deck is replaced with a fully continuous deck. The member retrofit and a continuous deck will increase structural redundancy of the bridge system and reduce live load-induced tension stresses in truss members that contain fatigue susceptible details. Our analysis results and recommendations are summarized as follows:

Retrofit of Fracture Critical Truss Members

Eight critical main truss members were selected from one half of each truss for the investigation of structural redundancy and retrofit need. The eight members actually represent thirty-two main truss members due to the nearly double symmetry of the trusses.

The selection of the eight truss members was based on the following criteria:

- Subject to tension under combined dead load and live load
- Containing the fatigue susceptible welded details at the interior diaphragm
- Subject to the highest magnitude of fatigue load stress range

The eight truss members selected based on these criteria are: L3-U4, L1-L2, U0-U1, U4-U5, U3-U4, L4-L5, L12-L13, and L13-L14. A redundancy analysis was performed to evaluate the structural consequence for the sudden failure of each of the eight members. Depending on the load case being considered, it was found that each of the eight members can be fracture critical, i.e., whose failure would result in the failure of at least one other main truss member or connection and thus cause instability of the structural system.

The following is a listing of identified fracture critical members (FCM's) for each of the four load cases investigated:

Load Case 1. Dead Load Only

FCM's without Dynamic Impact: U0-U1, L12-L13, L13-L14

FCM's with a 1.854 Dynamic Impact Factor: U0-U1, L12-L13, L13-L14

Load Case 2. Eight Lanes of Slow Moving HS-20 Truck Load (without multiple presence reduction and without live load impact)

FCM's without Dynamic Impact: U0-U1, U3-U4, L12-L13, L13-L14

FCM's with a 1.854 Dynamic Impact Factor: L3-U4, L1-L2, U0-U1, U3-U4, L12-L13, L13-L14

Load Case 3. Eight Lanes of Standstill HS-20 Truck and Lane Load (without multiple presence reduction and without live load impact)

FCM's without Dynamic Impact: all eight members

FCM's with a 1.854 Dynamic Impact Factor: all eight members

Load Case 4. LRFD Design Load

FCM's without Dynamic Impact: L1-L2, U0-U1, U4-U5, U3-U4, L12-L13, L13-L14

FCM's with a 1.854 Dynamic Impact Factor: L3-U4, L1-L2, U0-U1, U4-U5, U3-U4, L12-L13, L13-L14

We recommend that all the thirty-two main truss members represented by the eight fracture critical members be retrofitted with the steel plating scheme we have developed. The retrofit adds internal redundancy to the member and eliminates the possibility of a member fracture due to the fatigue of the poor welded details at the internal diaphragms. The retrofit also reduces live load stresses at the welded details.

Bridge Retrofit with a Complete Deck Replacement

The existing reinforced concrete bridge deck has a total of seven transverse expansion joints in the truss spans: one at each end of the truss cantilevers, one at the center of each of the three spans, and one at each pier of the center span. Additionally, there is a longitudinal deck joint along the bridge centerline, under the median barriers.

By making the entire bridge deck continuous throughout, our computer analyses have revealed that live load stress ranges decrease from 10% to 20% in truss members that contain the fatigue susceptible welded detail at the internal diaphragm. This reduction can be further enhanced if the connections between the floor truss top chord and the main truss are strengthened for longitudinal stiffness. However, the total weight of the new deck needs to be carefully determined so that the dead load stresses will not be significantly increased as a result. The use of light-weight concrete may be an option.

Additionally, we have also found that a continuous deck improves the structural redundancy of the bridge since less or no main truss member failure would occur as a result of a sudden failure of one of the three non-redundant members as listed previously. Combined with steel plating retrofit of the identified non-redundant members, a continuous deck will further improve the safety and performance of the deck truss system.

We are in the process of completing our study and the final report. Please feel free to contact us for any further questions or concerns.

1858

STATE OF MINNESOTA

Office of Governor Tim Pawlenty

130 State Capitol ♦ 75 Rev. Dr. Martin Luther King Jr. Boulevard ♦ Saint Paul, MN 55155

May 19, 2008

Mr. Bruce Mooty
Gray, Plant, Mooty
500 IDS Center
80 South Eighth Street
Minneapolis, MN 55402-3796

Via E-Mail and U.S. Mail

Dear Mr. Mooty:

Thank you for the opportunity to review the brief portion of the draft report that reflected information from your interview of Governor Pawlenty and Lieutenant Governor Molnau.

As I stated to you when I reviewed the document, my factual concerns related more to the factual information that was provided during interviews which was omitted in the draft document. The report does not reflect completeness in relation to the interviews with either the Governor or the Lieutenant Governor.

One example, is that both the Governor and Lieutenant Governor expressly raised the issue that there are typically many different types of engineers (for example, civil engineers – which includes specialization as bridge engineers, structural engineers, and construction engineers - electrical engineers, environmental engineers, materials engineers…) Education and professional practice as to one specialty does not necessarily qualify the individual to supervise technical aspects of work in another area or expertise. This omission is significant because it relates to the conclusions in the draft report.

In addition, the Lieutenant Governor expressly informed you that Bob Winters assumed the function of chief engineer after Mr. Differt left the agency. Mr. Winters will be providing you a letter under separate cover. Moreover, although your draft report comments on the chief engineer designation it does not discuss the historical or current function of the chief engineer designation. A brief review of Minnesota Statutes reflects that state law does not identify any

Voice: (651) 296-3391 or (800) 657-3717   Fax: (651) 296-2089   TDD: (651) 296-0075 or (800) 657-3598
Web site: http://www.governor.state.mn.us   An Equal Opportunity Employer

actions that require a chief engineer or assign any responsibilities to the chief engineer.

I also want to be clear that our review does not mean that we agree that the portions of the report I reviewed as a whole are factually accurate, complete or that we agree with the inferences or conclusions described. Our office did not participate in any interviews of other governors or commissioners. Indeed, because the report uses vague identifiers for those individuals, not even the individuals interviewed would be able to determine whether the report fairly describes their comments.

Sincerely,

Karen A. Janisch

Mooty, Bruce W.

From: Karen Janisch [Karen.Janisch@state.mn.us]
Sent: Monday, May 19, 2008 5:32 PM
To: Mooty, Bruce W.
Subject: ltr from bob winter

I wanted to be sure that you received the information from Bob Winter today. I am unclear whether he was e-mailing this to you tonight, or sending a letter tomorrow. Here is my understanding of what he will be sending. A signed letter should follow tomorrow.

Dear Mr. Mooty:

I was interviewed as part of your investigation, but was not asked about the chief engineer designation. I am a registered professional engineer and my experience and training is as a civil engineer. I have been employed by MnDOT for approximately 38 years.

As Deputy Commissioner, Mr. Differt held the title of chief engineer. Neither federal nor state law identify any specific duties or responsibilities to a "chief engineer." There are not specific substantive engineering duties attached to the title, rather an operational function that provides a contact with other state DOTs. After Mr. Differt left MnDOT, I was the most senior of the three engineers on MnDOT's senior management team and functioned as the chief engineer.

Sincerely,

Bob Winter

Karen Janisch
General Counsel to Governor Tim Pawlenty
130 State Capitol
Saint Paul, MN 55155
651-282-3705 - phone
651-296-0066 - fax

From:	Robert Winter [Bob.Winter@dot.state.mn.us]
Sent:	Tuesday, May 20, 2008 7:20 AM
To:	Mooty, Bruce W.
Cc:	Karen Janisch
Subject:	Chief Engineer
Attachments:	Doc10.doc

Doc10.doc (24 KB)

Please see the attached letter regarding MnDOT's Chief Engineer.
...Bob Winter

May 19, 2008

Mr. Bruce Mooty
Gray, Plant, Mooty
500 IDS Center
80 South Eighth Street
Minneapolis, MN 55402-3796

Via E-Mail and U.S. Mail

Dear Mr. Mooty:

I was interviewed as part of your investigation, but was not asked about the chief engineer designation. I am a registered professional engineer and my experience and training is as a civil engineer. I have been employed by MnDOT for approximately 38 years.

As Deputy Commissioner, Mr. Differt held the title of chief engineer. Neither federal nor state law identify any specific duties or responsibilities to a "chief engineer." There are not specific substantive engineering duties attached to the title, rather an operational function that provides a contact with other state DOTs. After Mr. Differt left MnDOT, I was the most senior of the three engineers on MnDOT's senior management team and functioned as the chief engineer.

Sincerely,

Robert Winter
Operations Division Director

work. Such inspection shall in no sense make any unit of
t or political subdivision or any railroad corporation a party
act, and shall in no way interfere with the rights of either the
t or the Contractor.

1512

Unacceptable and Unauthorized Work

k that does not conform to the requirements of the Contract
idered as unacceptable work unless otherwise determined in
with 1503.

ptable work, whether the result of poor workmanship, use of
aterials, damage through carelessness, or any other cause
ist prior to the final acceptance of the work, shall be
d replaced or otherwise corrected acceptably, immediately
of written order to do so.

one contrary to instructions of the Engineer, and any work
d that which is specified or ordered, will be considered as
d work and will not be paid for under the provisions of the
unauthorized work shall be removed by the Contractor, at no
he Department, upon receipt of written order to do so.

one without lines or grades having been given or with
t have not been given the required inspection, work done
roval of the Contract as required by law, and any Extra
rior to approval of a Supplemental Agreement therefor, and
xtra Work done prior to issuance of a Work Order/Minor
therefor, may be considered as unauthorized work and as
done at the Contractor's expense. Compensation for such
made only in the event that the Engineer determines it to
e. No compensation will be made for work that has not
zed in the Contract, by Supplemental Agreement, or by
Minor Extra Work.

ure on the part of the Contractor to comply immediately
der issued by the Engineer in accordance with this
, the Engineer will have authority to cause unacceptable
medied or removed and replaced, to have unauthorized
d, and to deduct the costs from moneys due or becoming
ntractor.

1513

Restrictions on Movement of Heavy Loads and Equipment

The hauling of materials and the movement of equipment to and from the Project and over completed structures, base courses, and pavements within the Project that are open for use by traffic and are to remain a part of the permanent improvement, shall comply with the regulations governing the operation of vehicles on the highways of Minnesota, as prescribed in the Highway Traffic Regulation Act.

The Contractor shall comply with legal load restrictions, and with any special restrictions imposed by the Contract, in hauling materials and moving equipment over structures, completed subgrades, base courses, and pavements within the Project that are under construction, or have been completed but have not been accepted and opened for use by traffic.

The Contractor shall have a completed Weight Information Card in each vehicle used for hauling bituminous mixture, aggregate, batch concrete, and grading material (including borrow and excess) prior to starting work. This card shall identify the truck or tractor and trailer by Minnesota or prorated license number and shall contain the tare, maximum allowable legal gross mass, supporting information, and the signature of the owner. The card shall be available to the Engineer upon request. All Contractor-related costs in providing, verifying, and spot checking the cab card information (including weighing trucks on certified commercial scales, both empty and loaded) will be incidental, and no compensation other than for Plan pay items will be made.

Equipment mounted on crawler tracks or steel-tired wheels shall not be operated on or across concrete or bituminous surfaces without specific authorization from the Engineer. Special restrictions may be imposed by the Contract with respect to speed, load distribution, surface protection, and other precautions considered necessary.

Should construction operations necessitate the crossing of an existing pavement or completed portions of the pavement structure with equipment or loads that would otherwise be prohibited, approved methods of load distribution or bridging shall be provided by the Contractor at no expense to the Department.

Neither by issuance of a special permit, nor by adherence to any other restrictions imposed, shall the Contractor be relieved of liability for damages resulting from the operation and movement of construction equipment.

Don Flemming/Minneapolis/URSCorp
04/14/2006 09:45 PM

To Ed Zhou
cc Mark Maves/Minneapolis/URSCorp@URSCORP
bcc
Subject Fw: Bridge 9030 Final Report

I just got this input from Gary this afternoon after talking to him about another issue. I am concerned about a recommendation from URS that would put off work until 2017.

What do you think, I feel we maybe better stay away from a long term delay recommendation.

Don

----- Forwarded by Don Flemming/Minneapolis/URSCorp on 04/14/2006 03:42 PM -----

"Gary Peterson " <Gary.Peterson@dot.state.mn.us>
04/14/2006 03:13 PM

To <Don_Flemming@urscorp.com>
cc "Bob Miller" <Bob.Miller@dot.state.mn.us>, "Daniel Dorgan" <Dan.Dorgan@dot.state.mn.us>, "Paul Kivisto" <Paul.Kivisto@dot.state.mn.us>
Subject Bridge 9030 Final Report

Don, after talking with the district, it looks like we have two improvement options that are being considered that should probably be addressed in your final report.

The first which I think we were on track with was, in the near future, to replace the deck and add deck continuity and also add redundancy to the 8 arch details.

The second option is to overlay the bridge now, and to hold off adding redundancy until it would be redecked in about 2017. (Unless there are be a couple of areas that are of particular concern or that have a history of problems that should dealt with during an overlay project). We may need to closely monitor the critical members during inspections, and have repair concepts developed that can be quickly detailed and installed.