ATTACHMENT 32 – COPY OF MINUTES OF MEETINGS, EMAILS AND HANDWRITTEN NOTES FROM JULY 24, 2006 THROUGH MAY 2007 AS IT RELATES TO PROPOSAL FOR STEEL PLATING OF ALL 52 FRACTURE CRITICAL TRUSS MEMBERS

(68 pages)

Br.9340 Time Line: Plating / Inspection Options Discussions 8/15/07
(based on Dan Dorgan and Gary Peterson e-mail)

July 24, 2006 – Meet with Metro Project Manager to discuss possible future plating contract.

October 4 - Inquiry from Metro PM about cost of plating

October 16th Replating Estimate is $1 to 1.25 Million

November 1: Metro Decision to Fund $1.5 million Project January 2008

November 7: URS proposes soliciting vendors for a monitoring system to report signs of crack initiation in lieu of adding plates.

November 7 Mn/DOT internal review comments note that a monitoring system should be considered if URS believes plating has risk.

November 14, Dan discusses monitoring option with URS. URS expresses confidence in plating option. Mn/DOT decides to remain with plating plan rather than pursue an uncertain monitoring system.

November 21, URS is asked to prepare plans and special provisions for and October 2007 plating contract letting.

November 27, Further discussions with URS on scope of work

December 4 – Meeting with Metro, Bridge and URS to discuss actions needed to meet October letting date. – Contractor input suggested.

December 19th - URS informs Mn/DOT that there are alternatives to plating to consider. January draft of eventual 2007 Executive Summary, with 3 equally viable options is sent.

December 19 discussed plating job at AGC meeting to ask input from interested contractors.

December 21 – Mn/DOT review indicates the in depth inspection and NDE option proposed by URS may be feasible since we should be able to detect the size crack discussed.

December 28. Sent package of scope, truss elevation, and typical plating detail to AGC.

January 9 – AGC invites member contractors to give input on Plating Contract.

January 10 – Propose meeting to discuss how NDT can eliminate additional or perhaps all the plating, and develop scope of work to detail plating of additional members. URS discusses possibly of not plating any members.

January 12 – Conference call with URS scheduled for January 17th.

January 17 – Dan's notes from conference call –

- Detailed review of fatigue using fracture mechanics

- Decision to do NDT in south span in 2007. If confident of visual and UT testing proceed to north span. If not confident, go with plating repair.

January 18 - Gary to Metro reschedule October 2007 plating project until FY 2009 after an evaluation of in depth visual and NDT inspection methods and results is complete.

March 2007 – Contract signed with URS to review Mn/DOTs inspection results and to develop repair plans and specification if plating necessary.

May 2007 – Mn/DOT and Metro Inspection teams perform in-depth and NDT inspection of half of the critical members identified in URS report

August 20, 2007 – meeting scheduled to review methods and results and to determine if inspections should continue in lieu of plating, or to proceed with plating.

From: Gary Peterson
To: Jerome Adams
Date: Mon, Oct 16, 2006 4:38 PM
Subject: Re: I35W Mississippi River Bridge

I just got back and am kind of backed up in September. Look at calendars and pick a date in October. Attached is an estimate for the replating work. Our total is for a bit over $1 million. I tend to think this may be a little low and may run as high as 1.25 million.

I believe Paul did add to his repair recommendations for next years overlay that metro should schedule a replating contract in the near future. Even at 1.25 million, it seems this would be a good investment considering the consequence of failure, even though that chance is low.

Gary Peterson
Bridge Construction & Maintenance Engineer
Mn/DOT Bridge Office
3485 Hadley Avenue North
Oakdale MN 55128
[redacted]

>>> Jerome Adams 10/4/2006 9:08 AM >>>
Gary,

How are things going? We were going to meet again in Sept., or Oct. now, to talk about the costs of the different steel options listed in section 9 of the attached document. Then we were going to make a recommendation for the bridge and strategize on how to pitch this to Metro.

Where are you in regards to this and when would you like to meet?

Jerome Adams, P.E.
Senior Engineer
MNDOT
Metro Design
1500 West County Rd. B2
Roseville, MN 55113
[redacted]

CC: Daniel Dorgan; Jeff Southward; Paul Kivisto

From: Gary Peterson
To: Jeff Southward
Date: Mon, Oct 16, 2006 9:55 AM
Subject: Fwd: I35W Mississippi River Bridge

Jeff, did you ever come up with a cost for the plating?

>>> Jerome Adams 10/4/2006 9:08 AM >>>
Gary,

How are things going? We were going to meet again in Sept., or Oct. now, to talk about the costs of the different steel options listed in section 9 of the attached document. Then we were going to make a recommendation for the bridge and strategize on how to pitch this to Metro.

Where are you in regards to this and when would you like to meet?

Jerome Adams, P.E.
Senior Engineer
MNDOT
Metro Design
1500 West County Rd. B2
Roseville, MN 55113
[redacted]

Minnesota Department of Transportation

Metropolitan District – Waters Edge
Jerome Adams, P.E.
Design
1500 West County Road B2
Roseville, MN 55113

[redacted]

Minutes

July 24, 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 will occur. 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 will allow 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 also determines that the bridge is Fracture Critical, which means that failure of part of the arch truss could cause the entire span or several spans of the bridge to collapse.

So what are the chances that one of the spans will fail? The URS report says that the risk is low. 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. Although it is unlikely that a crack would form due to the low stresses in the truss members, the possibility of crack formation resulting from flaws in materials or workmanship cannot be completely ruled out. Crack formation in any of the 16 fracture critical members identified by URS could lead to the collapse or partial collapse of the bridge if not discovered and repaired promptly.

The rate of crack growth is directly related to stress in the bridge member. Based on the low stresses discussed in the URS report, Mn/DOT engineers feel more confident that a crack in a critical steel member can be found before it reaches a critical length. An inspection program which closely inspects the 20 critical members on a regular basis will need to be developed.

5.0 What's the implication of a steel member failing due to a crack?

It's likely the bridge will be closed to all traffic until the significance of the crack can be discerned. This means that Interstate 35W will be completely closed in both directions at the Mississippi River until the problem is either fixed, or until it is determined that it can be partially opened. The duration of time the bridge could be restricted ranges from one month to the time necessary to reconstruct the bridge. See the "Steel Reinforcement Options" section below.

At the very worst, cracks could grow rapidly until the member failed which is likely to result in sudden collapse or partial collapse of the bridge.

6.0 What's the resolution to finding a crack on the bridge?

Small cracks can be ground out or the crack can sometimes be stopped by drilling a hole at the tip of the crack. It's often necessary to plate over larger cracks in order to transfer stresses through the cracked member should the crack continue to grow. The URS proposal is to bolt high strength plates onto the sides of critical members to fully replace strength of the critical member should it crack, and making the member redundant (not susceptible to failure) if the crack became critical. URS recommends plating over 20 members to in order to prevent possible failure, or to prevent disruption to traffic that would result if a crack were discovered in a critical member.

7.0 Winter weather and choosing when to reinforce the bridge.

If we choose to program a project to reinforce the steel now, then Mn/DOT can choose the exact time, conditions, and manner that the work will be prosecuted to maximize cost effectiveness, quality, and safety. If we wait until an inspection finds a crack before we reinforce the steel, then random chance and weather will dictate the time, conditions, and manner that the work will be prosecuted. This will negatively impact cost, quality, and safety.

Bridge inspections do not occur in the winter for safety reasons, such as icy roads that cause crashes, and frigid temperatures that make it impossible to operate the equipment. However, it

is more likely that a crack will cause a failure in the steel during the winter, because the cold temperatures make the steel more brittle.

The weather may make it difficult or impossible to repair any cracks in the winter. It may be difficult or impossible to mobilize a crane on a barge on the frozen river below. Frigid temperatures, storms, snow, and ice may make it difficult or impossible to prosecute the work either safely or effectively. It may also be difficult to execute an emergency contract and mobilize a contractor in the middle of the winter.

This could mean that we have to wait one, two, or even three months to fix the problem, and depending on the severity the bridge could be closed for that entire time.

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. But there is a further risk that the damage is beyond fixing, and the bridge will have to be condemned. This means 35W will be closed for a minimum 5 years until a new bridge is finished.

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 to spend the money to actually install the steel right now. Under an emergency contract we MIGHT be able to have the bridge closed for only one month weather and contractor availability permitting.

9.2.2 Risk: Cracks grow more rapidly in the winter when working conditions are tough at best. Bridge inspections do not occur in the winter, so there is some risk between the theorized formation of the crack in the winter, and the time we inspect the bridge later in the year. The bridge will be closed until the work is complete. But there is a further risk that the damage is beyond fixing, and the bridge may have to be condemned. This means 35W will be closed for a minimum 5 years until a new bridge is finished.

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: Must pay approximately 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. This includes the creation of an aggressive inspection program for the bridge.

CC: Tom O'Keefe

From: Gary Peterson
To: Larry Aamodt
Date: Wed, Nov 1, 2006 3:50 PM
Subject: Re: Estimated Bridge No. 9340 Replacement Cost

Thanks Larry. Looks good for a first guess estimate.

>>> Larry Aamodt 11/1/2006 1:46 PM >>>
Mr. Adams,

After reviewing similar situations within the metro area it was felt that a Post Tensioned Concrete Box bridge would be the most logical structure type to consider as a replacement for inplace Bridge No. 9340. Like structures reviewed were the two major bridges of the Wakota Project, the Lexington Avenue bridge (Bridge No. 62912 let in 2001) and the Wabasha Street bridge (Bridge No. 62555 let in 1996). A signature type structure such as a cable stayed or steel arch bridge was not considered in trying to arrive at an approximate bridge cost.

Recent discussions dealing with the primary structures of the Wakota Project were of a major consideration in trying to arrive at an approximate cost for the replacement bridge.

An approximate cost for an assumed post tensioned concrete box using the same square foot area of the inplace bridge would be $65,750,000.00. The length and width of the proposed replacement bridge were not altered to arrive at this approximate bridge replacement cost. An additional approximate inplace bridge removal cost of $3,000,000.00 is not included in the replacement cost.

It was felt that a bridge which would be of a greater width to handle the capacity of traffic in the project location should be considered. So, a post tensioned concrete box structure with greater width but of the same length of the inplace bridge having a potential deck area greater than the inplace structure would be approximately $95,000,000.00. 10-twelve foot lanes, 2-ten foot outside shoulders, 2-ten foot inside shoulders, 1-three foot median barrier and 2-one and a half foot outside barriers were assumed in arriving at an anticipated structure width of one hundred and sixty-six feet. Again, an additional bridge removal cost of $3,000,000.00 is not included in the replacement cost.

Any additional potential costs for right-of-way purchase, approach work, temporary structures, anti-icing systems, traffic control or staging have not been included in the computations created to arrive at the approximate costs for the potential replacement structures.

All estimated costs were done using 2006 dollars.

If you have any questions or need any other information, you can contact me.

Larry Aamodt
Preliminary Bridge Unit
Bridge Office
Mail Stop 610
3485 Hadley Avenue North
Oakdale, MN 55128-3307

From: Gary Peterson
To: Kevin Western
Date: Wed, Nov 1, 2006 5:41 PM
Subject: 9340 I-35W over Mississippi

We had a meeting with Metro on bridge 9340 this afternoon where it was decided to fund ($1.5 million) a project to perform the replating recommended by URS. The project will be scheduled for letting January 2008 (to provide time to special order steel). They asked if we could have plans ready in October. I said yes. Jerome will get it added to PPMS shortly.

I think we still need to get the final report from URS, but we should also decide if we want do the plans and specs or maybe have urs or someone else do it. All that drilling will need some good quality control specs.

CC: Daniel Dorgan; Paul Kivisto

From: <Don_Flemming[redacted]
To: <Daniel.Dorgan[redacted]
Date: Tue, Nov 7, 2006 12:05 PM
Subject: Fw: RFP for a monitoring system

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

[redacted]

----- Forwarded by Don Flemming/Minneapolis/URSCorp on 11/07/2006 11:35 AM -----

Ed Zhou/HuntValley/URSCorp
11/07/2006 10:08 AM

To [redacted]
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)

[redacted]

[redacted]

1. Bridge Structure Overview

Bridge 9340 carries Interstate 35W across the Mississippi River just east of downtown Minneapolis. Built in 1967, the structure is a three-span continuous deck truss with steel multi-girder and continuous concrete approach spans. The bridge carries eight lanes of traffic, four lanes in each direction, and has a total length of nearly 2,000-ft including the approach spans. The span configuration of the deck truss is approximately 266-ft, 456-ft, and 266-ft. Each side span also has an approximately 38-ft cantilever that supports the cross-girder of the adjacent approach span. The reinforced concrete deck has a total of seven transverse expansion joints in the truss spans: one at each end of the 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.

Figure 1 shows the general plan and elevation of the bridge; and **Figure 2** depicts the framing plan of the deck truss, both extracted from the 1965 original plans. **Figure 3** shows an overview of the bridge looking north-west, and **Figure 4** is a view above the bridge deck looking north.

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, as shown in **Figure 5** and **Figure 6**. In the main truss tension chords the original contract plan specified eight 3½" x ⅜" x 3½" steel bars welded to both the truss chord and the diaphragm and located along the perimeter of the diaphragm. According to current AASHTO fatigue provisions, the weld toe of fillet welded longitudinal attachments of lengths equal to or greater than 2" and less than 4" are Category D fatigue details. If poor workmanship or fabrication errors resulted in welds at some locations being 4" in length the details would be classified as a Category E fatigue detail.

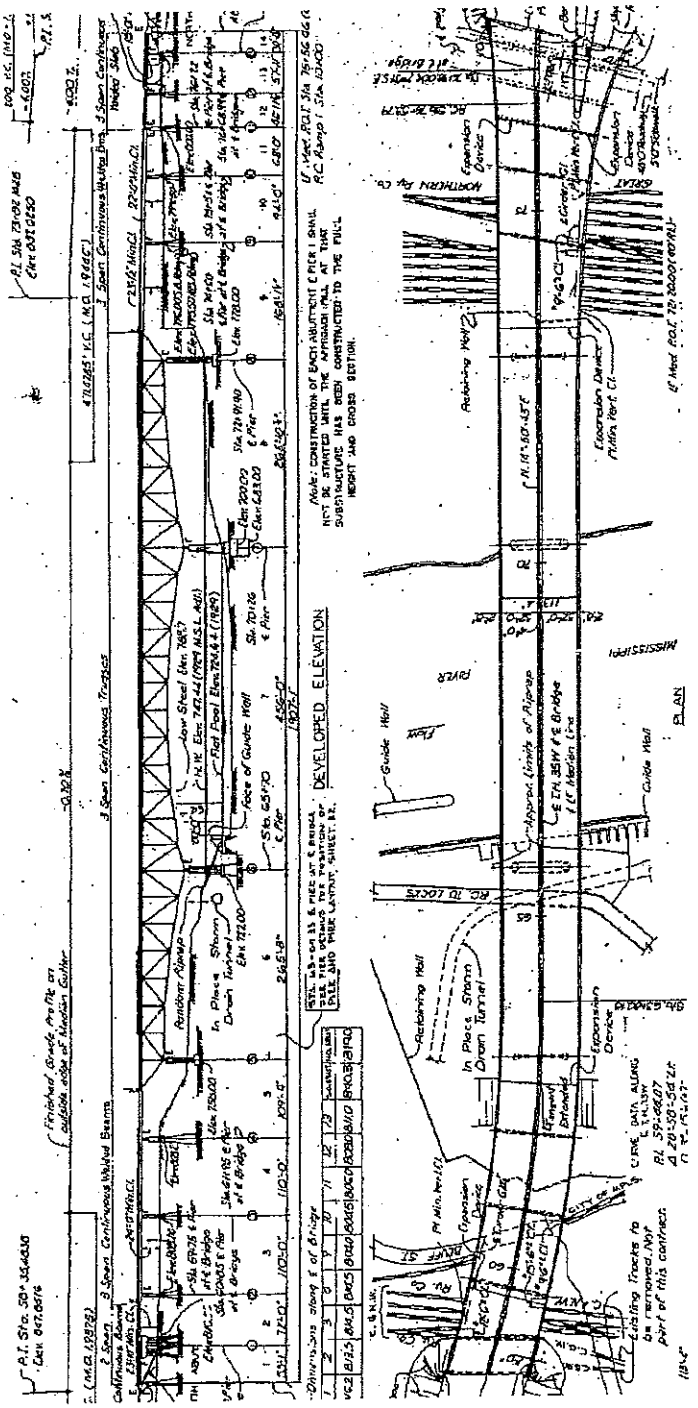


Figure 1. Bridge 9340 General Plan and Elevation from Original Contract Plans

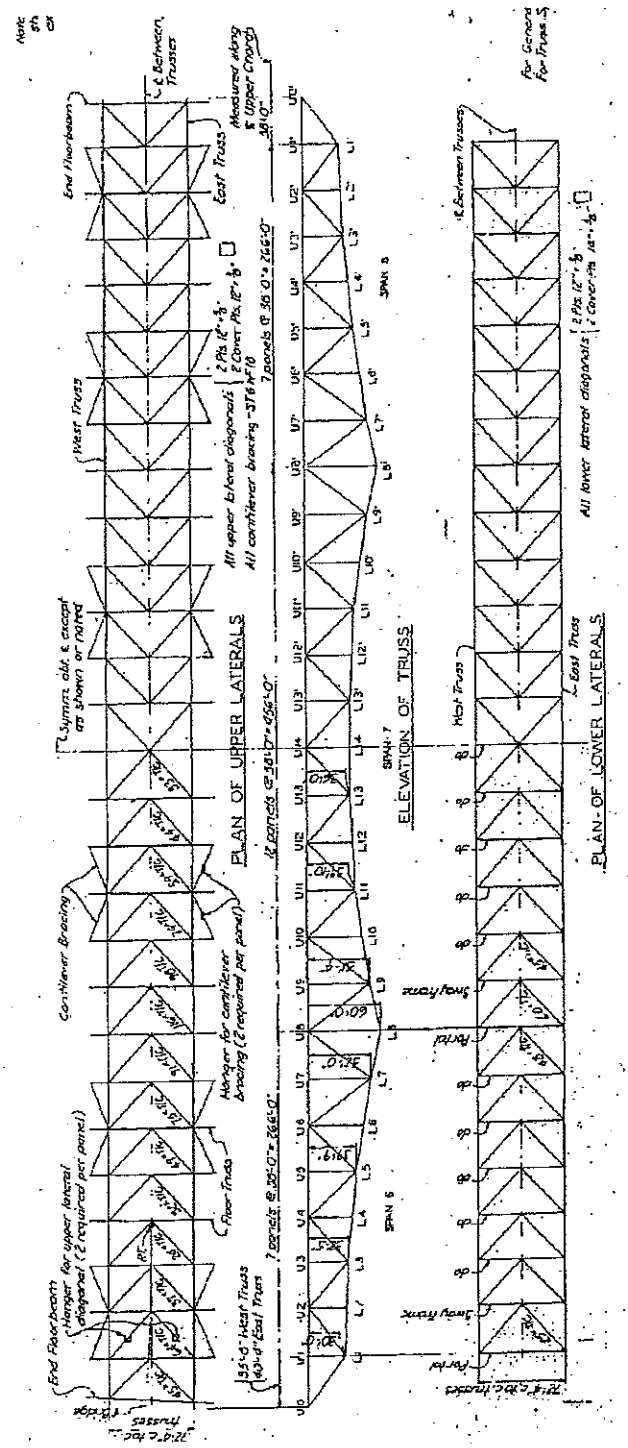


Figure 2. Deck Truss Framing Plan from Original Contract Plans

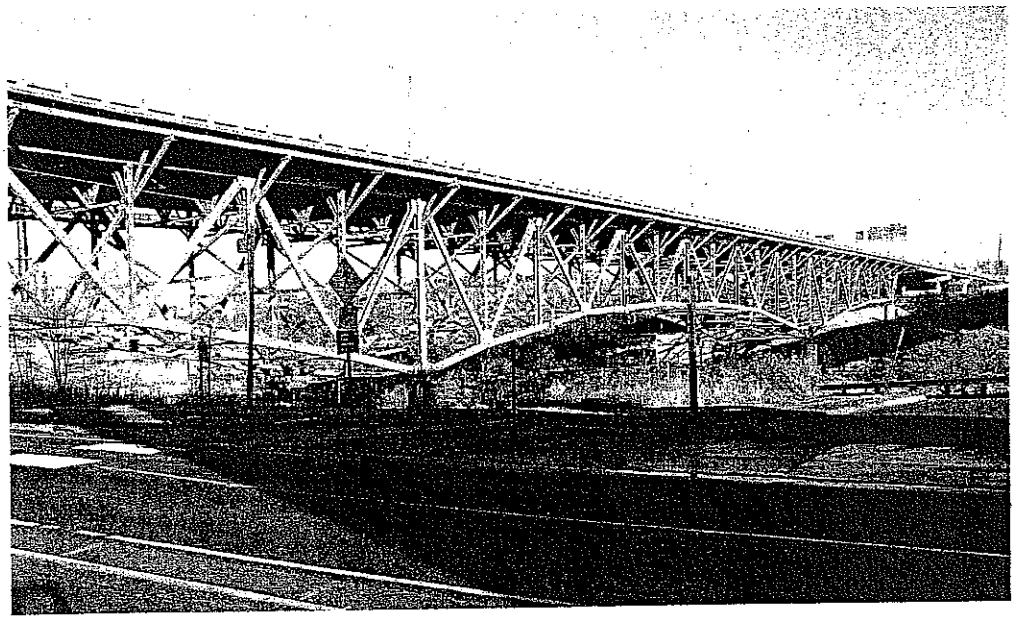


Figure 3. Bridge 9340 Overview Looking North-West

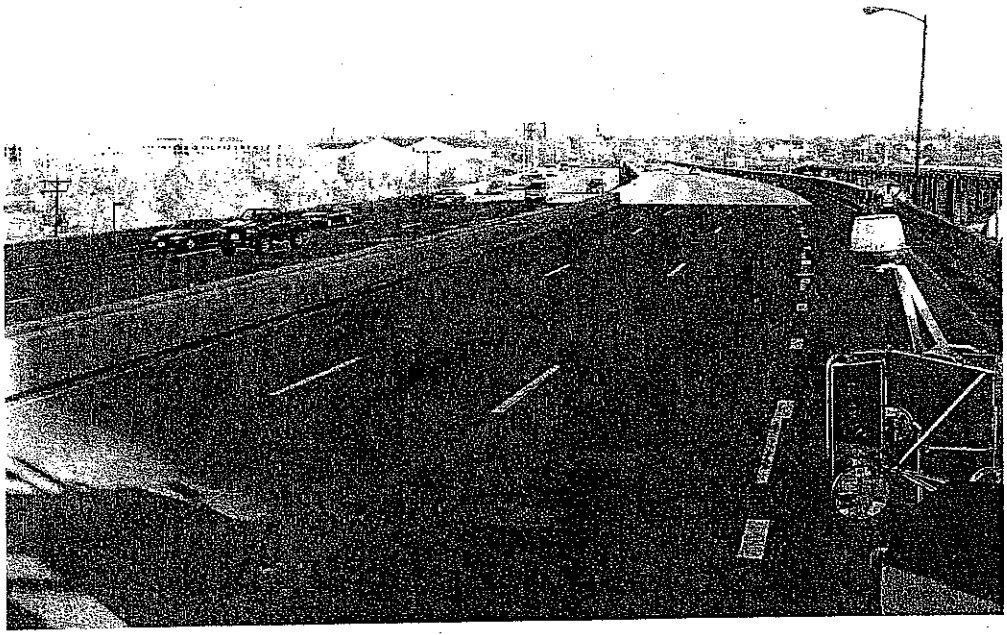


Figure 4. Bridge 9340 Deck View Looking North

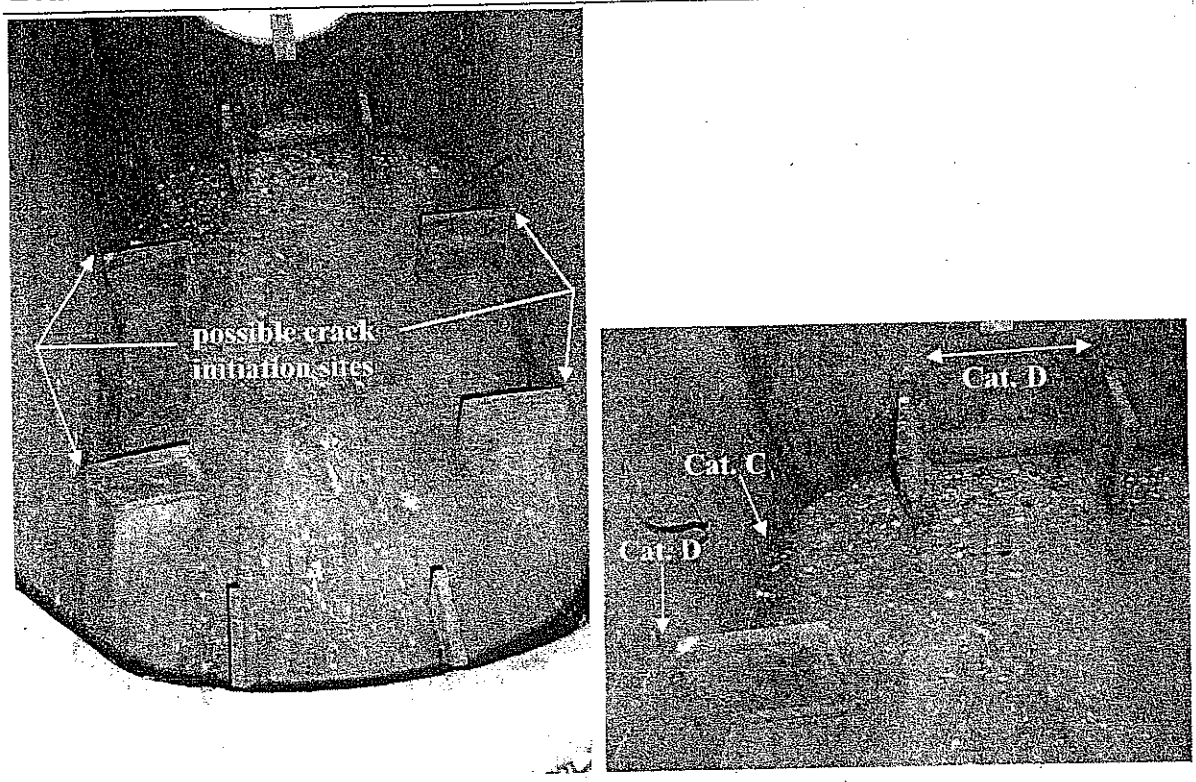


Figure 5. Fatigue Susceptible Details inside Main Truss Tension Chords

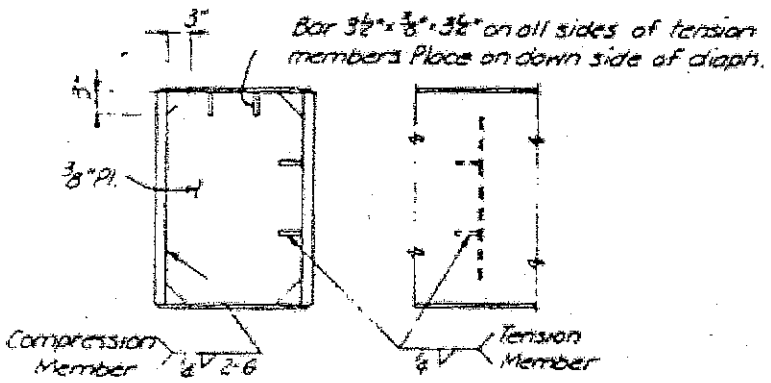


Figure 6. Welded Diaphragm Details in Main Truss Members from Original Contract Plans

2. Invitation for Proposal for a Steel Crack Monitoring System

URS is evaluating the feasibility of a steel crack monitoring system, to be recommended to the bridge owner (Mn/DOT) for installation on selected fracture critical truss members. These members are Upper Chords U0-U1 and U4-U5, as well as Lower Chords L1-L2, L12-L13 and L13-L14. Considering the double symmetry of the deck truss system, there are a total of twenty members to be monitored for steel cracking. The most susceptible locations for crack initiation are likely the weld toes on the web plates, as marked in the left photo of **Figure 5**. Each truss chord typically contains three welded diaphragms along its length, each as depicted in **Figure 5** and **Figure 6**. No cracks are believed to be in existence currently. The primary objective of the monitoring system is to timely report any signs of crack initiation and/or propagation. The monitoring system should have at least the following features:

1. A complete system containing sensors, wiring and data acquisition, processing and recording features for long term continuous monitoring. AC power may be available on the bridge, but a backup solar power system should be considered for short-term, accidental power outage for non-interrupted monitoring.
2. The system should have wireless data transmission features and the capability of alerting the bridge owner for truss member locations where unusual signals are detected as possibility of steel cracking activities.
3. The system should be suitable for long term monitoring with low maintenance. Its working status should also be conveniently verified during the monitoring process.

The proposal should include the following:

1. Detailed descriptions of the monitoring system, including sensors, wiring and data acquisition, processing, and recording, as well as wireless data transmission, monitoring and alerting for crack activities.
2. For the sensing and wireless data transmission technologies, provide detailed supporting materials as well as history of actual applications on bridges.
3. Cost, in terms of initial cost and annual fee for continuous monitoring. Access for initial installation should be expected to be provided by Mn/DOT.

File
Bridge 9340

From: Gary Peterson
To: Daniel Dorgan
Date: 11/7/2006 5:19:11 PM
Subject: Fwd: Fw: RFP for a monitoring system

Dan, I did review this briefly and discussed with Kevin.

(1) 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.

(2) 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.

(3) 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.

11/14/06
Discussed with DOT by phone. Don & Ed still confident in plating method. Therefore, decided they do not need to pursue monitoring. Add Dan want the certainty of a reinforced member rather than relying on monitoring. D2D.

[redacted] 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

[redacted]

---- Forwarded by Don Flemming/Minneapolis/URSCorp on 11/07/2006 11:35 AM

From: <Don_Flemming[redacted]
To: <dan.dorgan[redacted]
Date: 11/7/2006 1:01:03 PM
Subject: Fw: RFP for a monitoring system

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

[redacted]

See Gary's note:

- Would we monitor - Weld toe 4 per diap, 3 per member 20 membe
- or Webs.
- If weld toe, would small fracture trigger System or could it fracture weld & propagate w/o trigger System.
- Concern monitoring will lessen inspection.

---- Forwarded by Don Flemming/Minneapolis/URSCorp on 11/07/2006 11:35 AM ----

Ed Zhou/HuntValley/URSCorp
11/07/2006 10:08 AM

To: Don [redacted]
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)

[redacted]

1. Bridge Structure Overview

Bridge 9340 carries Interstate 35W across the Mississippi River just east of downtown Minneapolis. Built in 1967, the structure is a three-span continuous deck truss with steel multi-girder and continuous concrete approach spans. The bridge carries eight lanes of traffic, four lanes in each direction, and has a total length of nearly 2,000-ft including the approach spans. The span configuration of the deck truss is approximately 266-ft, 456-ft, and 266-ft. Each side span also has an approximately 38-ft cantilever that supports the cross-girder of the adjacent approach span. The reinforced concrete deck has a total of seven transverse expansion joints in the truss spans: one at each end of the 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.

Figure 1 shows the general plan and elevation of the bridge; and **Figure 2** depicts the framing plan of the deck truss, both extracted from the 1965 original plans. **Figure 3** shows an overview of the bridge looking north-west, and **Figure 4** is a view above the bridge deck looking north.

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, as shown in **Figure 5** and **Figure 6**. In the main truss tension chords the original contract plan specified eight 3½" x ⅜" x 3½" steel bars welded to both the truss chord and the diaphragm and located along the perimeter of the diaphragm. According to current AASHTO fatigue provisions, the weld toe of fillet welded longitudinal attachments of lengths equal to or greater than 2" and less than 4" are Category D fatigue details. If poor workmanship or fabrication errors resulted in welds at some locations being 4" in length the details would be classified as a Category E fatigue detail.

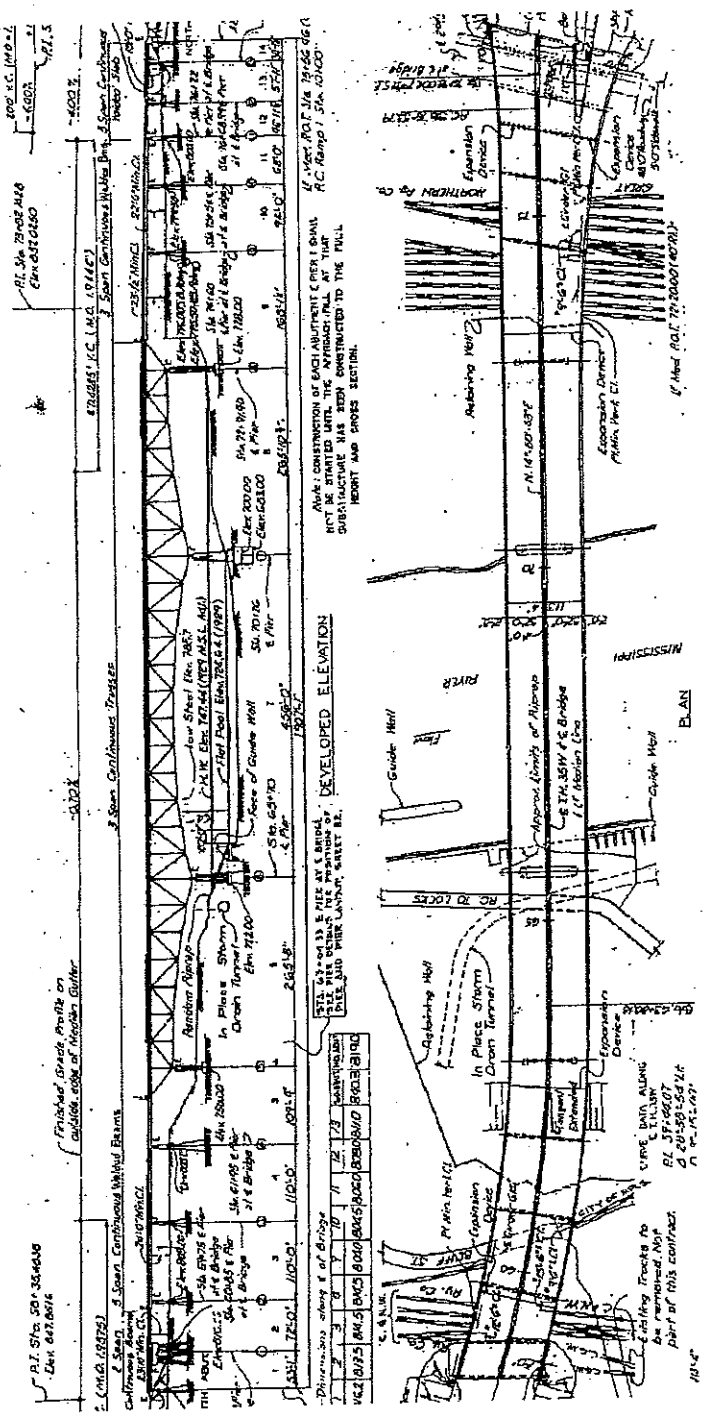


Figure 1. Bridge 9340 General Plan and Elevation from Original Contract Plans

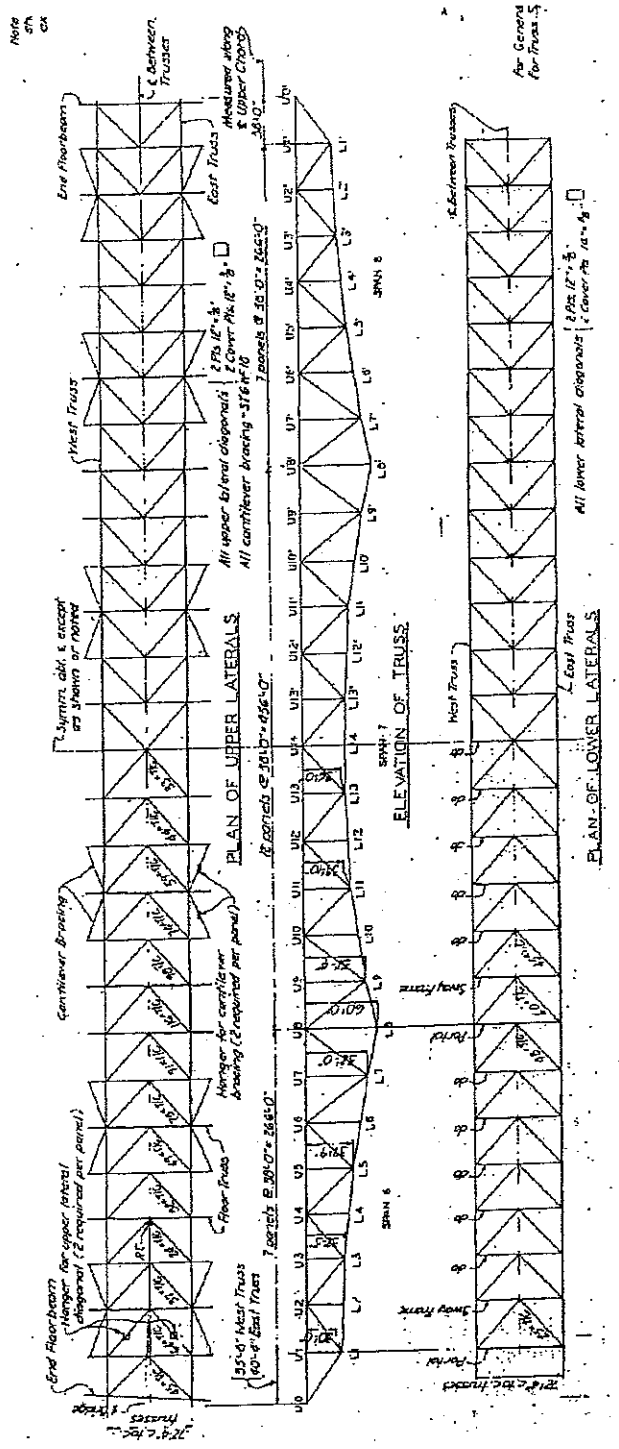


Figure 2. Deck Truss Framing Plan from Original Contract Plans

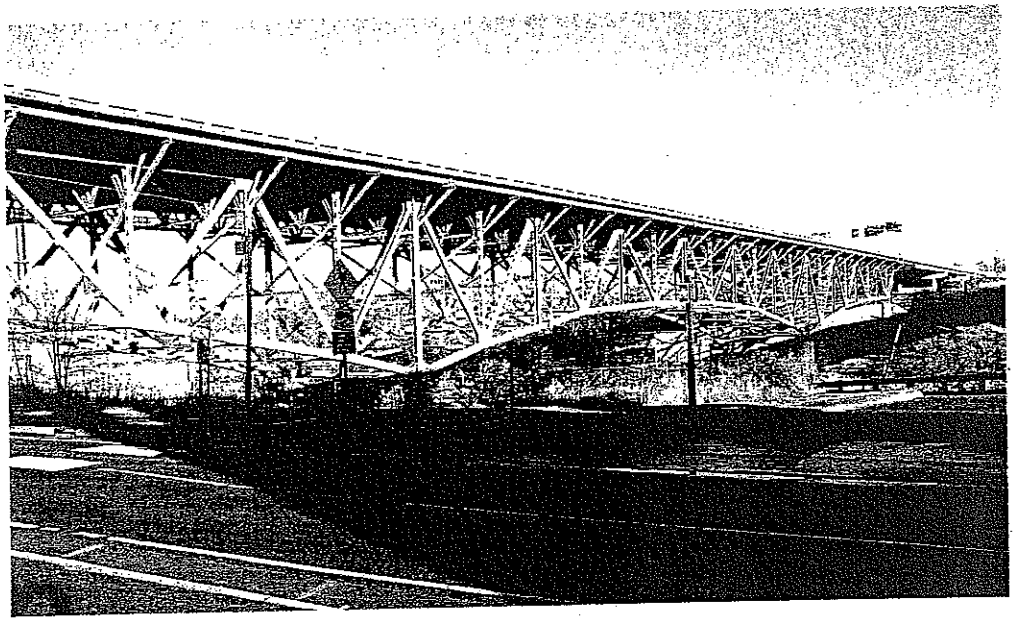


Figure 3. Bridge 9340 Overview Looking North-West

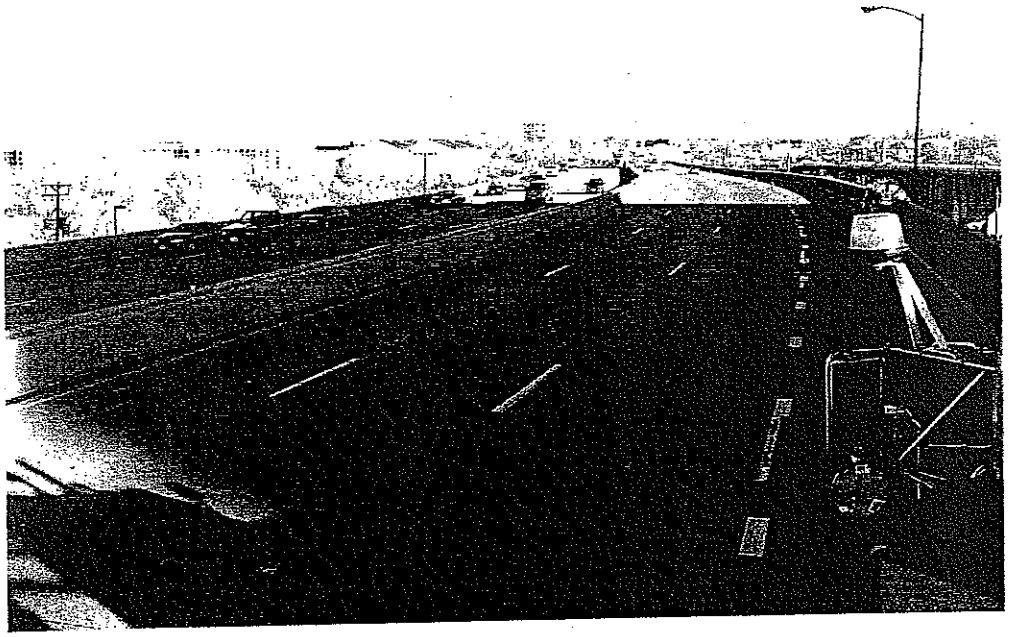


Figure 4. Bridge 9340 Deck View Looking North

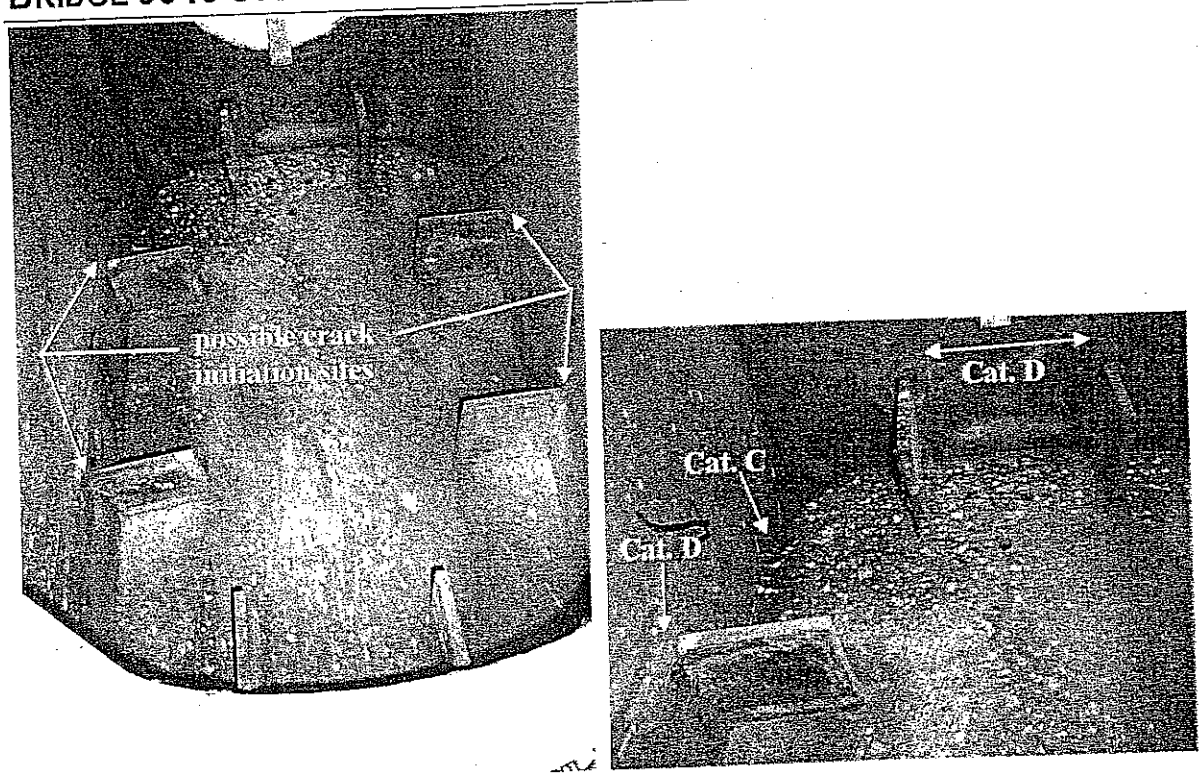


Figure 5. Fatigue Susceptible Details inside Main Truss Tension Chords

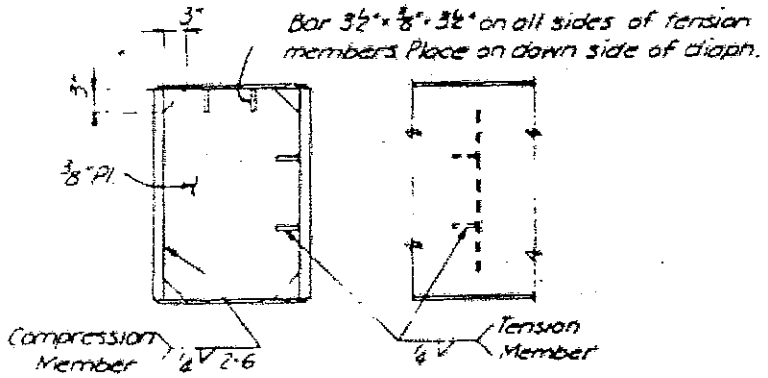


Figure 6. Welded Diaphragm Details in Main Truss Members from Original Contract Plans

2. Invitation for Proposal for a Steel Crack Monitoring System

URS is evaluating the feasibility of a steel crack monitoring system, to be recommended to the bridge owner (Mn/DOT) for installation on selected fracture critical truss members. These members are Upper Chords U0-U1 and U4-U5, as well as Lower Chords L1-L2, L12-L13 and L13-L14. Considering the double symmetry of the deck truss system, there are a total of twenty members to be monitored for steel cracking. The most susceptible locations for crack initiation are likely the weld toes on the web plates, as marked in the left photo of **Figure 5**. Each truss chord typically contains three welded diaphragms along its length, each as depicted in **Figure 5** and **Figure 6**. No cracks are believed to be in existence currently. The primary objective of the monitoring system is to timely report any signs of crack initiation and/or propagation. The monitoring system should have at least the following features:

1. A complete system containing sensors, wiring and data acquisition, processing and recording features for long term continuous monitoring. AC power may be available on the bridge, but a backup solar power system should be considered for short-term, accidental power outage for non-interrupted monitoring.
2. The system should have wireless data transmission features and the capability of alerting the bridge owner for truss member locations where unusual signals are detected as possibility of steel cracking activities.
3. The system should be suitable for long term monitoring with low maintenance. Its working status should also be conveniently verified during the monitoring process.

The proposal should include the following:

1. Detailed descriptions of the monitoring system, including sensors, wiring and data acquisition, processing, and recording, as well as wireless data transmission, monitoring and alerting for crack activities.
2. For the sensing and wireless data transmission technologies, provide detailed supporting materials as well as history of actual applications on bridges.
3. Cost, in terms of initial cost and annual fee for continuous monitoring. Access for initial installation should be expected to be provided by Mn/DOT.

From: Gary Peterson
To: Jerome Adams
Date: Wed, Nov 22, 2006 1:27 PM
Subject: Fwd: Bridge No. 9340 Plating Contract

Jerome. Please reveiw and get back to me. I assume there is someone in the district that should be a contact on some of Don's questions. i think this is usually the PM. Can I have him contact you for info on the 2nd paragraph below?

[redacted]

Gary, Kevin Western and Bob Miller talked to me today about putting together a plan for a letting in October to plate the 9340 bridge. They asked that we prepare special provisions and plan sheets and I am trying to develop a scope and cost for the additional work. I have a few questions on the special provisions and plans and I would appreciate your ideas and direction.

In regard to traffic control I would assume that the District Construction personnel would write that special provision and also any discussion of a staging area for the work. Should we be concerned about any discussion of river access and any clearance issues in that regard. I assume that we would include a traffic control sheet in the plan.

One of our other concerns is the verification of the loaction of the diaphragms for the members for which the shop drawings were not found. It would seem like a very difficult task to field verify the diaphragm locations in advance of fabrication and the start of construction before scaffolding is inplace. One of the thoughts is to prepare plates to the best of our knowledge, but have some additional plate on hand in the rare event that diaphragms are spaced differently in a member. Tom Merritt seemed to indicate that the contractor would have to purchase a certain minimum amout of 100 ksi plate and so there may be excess material available.

Would scaffolding issues be left entirely to the contractor or does the DOT want some minimum requirements?

I also assume that Tom Merritt would have some requirements on the drilling the inplace bridge members as well as for drilling or punching of the plates and we would look to Tom to provide this input.

Thanks for your help.

Don

[redacted]

From: Gary Peterson
To: Don_Flemming[redacted]
Date: Mon, Nov 27, 2006 5:27 PM
Subject: Re: Bridge No. 9340 Plating Contract

Don, I talked a bit with Jerome Adams today (651 582-1320) regarding your questions. Apparently they hadn't given a lot of thought yet to some of the up front work, particularly the environmental work that may come into play if we need to go into the river. He plans to set up a meeting of Metro players who might be involved in decisions regarding work staging areas, R/W, and environmental issues. Some of these areas can be done by Metro, but because of a short time line on this project and availability of staff, you may be asked to chase down some of this information as part of your scope of work. I suggested to Jerome that we invite you or one of your staff to this meeting in order to better understand tasks you may be asked to do.

I think your issues regarding traffic control plans and clearance during construction may have to wait until then.
With regard to locating the diaphragms for members for which we do not have shop drawings, I agree with the solution you propose. A couple of extra blank plates won't be a big cost.

We should discuss scaffolding requirements. I'm not sure what you mean, and how that might not already be covered by specifications?

Quality control. These are issues we can provide input on your approach to the specifications at a later date. There must be some standards that apply.
We would probably want the contractor to have a written quality control plan written according to an accepted standard and describing his testing or inspection program.

Gary Peterson
Bridge Construction & Maintenance Engineer
Mn/DOT Bridge Office
3485 Hadley Avenue North
Oakdale MN 55128
[redacted]

Gary, Kevin Western and Bob Miller talked to me today about putting together a plan for a letting in October to plate the 9340 bridge. They asked that we prepare special provisions and plan sheets and I am trying to develop a scope and cost for the additional work. I have a few questions on the special provisions and plans and I would appreciate your ideas and direction.

In regard to traffic control I would assume that the District Construction personnel would write that special provision and also any discussion of a staging area for the work. Should we be concerned about any discussion of river access and any clearance issues in that regard. I assume that we would include a traffic control sheet in the plan.

One of our other concerns is the verification of the loaction of the diaphragms for the members for which the shop drawings were not found. It would seem like a very difficult task to field verify the diaphragm locations in advance of fabrication and the start of construction before scaffolding is inplace. One of the thoughts is to prepare plates to the

best of our knowledge, but have some additional plate on hand in the rare event that diaphragms are spaced differently in a member. Tom Merritt seemed to indicate that the contractor would have to purchase a certain minimum amout of 100 ksi plate and so there may be excess material available.

Would scaffolding issues be left entirely to the contractor or does the DOT want some minimum requirements?

I also assume that Tom Merritt would have some requirements on the drilling the inplace bridge members as well as for drilling or punching of the plates and we would look to Tom to provide this input.

Thanks for your help.

Don

[redacted]

CC: Bob Miller; Jerome Adams

From: Jerome Adams
To: Dalton, Richard; Don_Flemming[redacted] Engh, Michael; Griffith, John; Herman, Michael; Kivisto, Paul; Kordosky, Steve; Lunceford, Marv; Parzyck, Rebecca; Peterson, Gary; Pribula, Mark; Reynolds, Michael J; Schultz, Roger
Date: Tue, Dec 5, 2006 11:54 AM
Subject: Br..9340 steel reinforcement minutes

Please read the attached. Please contact me if I made any incorrect statements or omitted any information.

Jerome Adams, P.E.
Senior Engineer
MNDOT
Metro Design
1500 West County Rd. B2
Roseville, MN 55113
[redacted]

Minnesota Department of Transportation

Metropolitan District – Waters Edge
Jerome Adams, P.E.
Design
1500 West County Road B2
Roseville, MN 55113

[redacted]

Dec. 4, 2006
12:15 PM to 2:00 PM
Waters Edge Conf. Rm. 194
Subject: Br. 9340 TH 35W over the Mississippi River project coordination meeting
Attendees:

Jerome Adams, Meeting chair/recorder	Paul Kivisto – Oakdale Bridge
Gary Peterson – Oakdale Bridge	Mark Pribula – Metro Bridge Maintenance
Rebecca Parzyck – Metro R/W	Steve Kordosky – Oakdale Construction
Mike Engh – Metro Traffic Control	Mike J. Reynolds – Metro Traffic Control
Don Flemming – URS Corporation	Rick Dalton – Metro Environmental Docs.

1.0 Project Description

HWY NUMBER	TH 35W
COUNTY	Hennepin
LETTING DATE	October 2007
DESCRIPTION OF WORK AND WORK LOCATION	Structural Steel Reinforcement for Bridge 9340 – TH 35W over the Mississippi River in Minneapolis
WORK TYPE	Bridge Rehabilitation (BRRH)
SECONDARY WORK TYPE	Bridge Repair Other Detour Agreement R/W, Right of Way Railroad Agreement
COST	$1.5 million
SOURCE OF FUNDING	Bridge Improvement Fund
MI (Length of Project)	Less than 1/4 mile
BEG REFERENCE POINT	018+00.357
END REFERENCE POINT	018+00.719
FISCAL YEAR	2008
AREA ENGINEER	John Griffith
PREL. PROJ MGR	Jerome Adams
FIN DES PROJ MGR	Jerome Adams
RESIDENT ENGINEER	Steve Kordosky
DESIGN ENGINEER	Mike Herman
RAIL AGREEMENT*	Yes

2.0 Environmental Documentation

Rick Dalton and I will begin the environmental review process for this project. This project does not require a Project Memo, EA, or EIS. Rick and I will still send out a questionnaire explaining the project to all of the dozens of agencies and entities that we typically have to deal with on Highway Projects. This will insure that Mn/DOT is addressing all issues that we are required to address even if we don't know we have to address them.

2.1 Contaminated Properties

Part of this review will include a survey of contaminated properties. Of special concern is the dredging pile placed under the north end of the steel truss.

2.2 Lead

It is assumed that the bridge has significant amounts of lead paint. The plans and special provisions shall explain the requirements for disposing any lead paint removed from the bridge. Jerome Adams will discuss the lead paint issue with CO Environmental Services.

3.0 Right Of Way Access

Becky Parzyck will begin pulling titles for the property underneath the bridge. She will then determine which parcels Mn/DOT needs to get permission to access during construction. Becky and Jerome will attempt to get Zero Dollar Permits To Construct on any sites that Mn/DOT does not have access. The process of pulling Titles will take 3 months and will be completed by March 5, 2007. The process of asking for Zero Dollar Permits will take one more month and will be completed April 2, 2007.

As of April 2, 2007, we will be able to report back to the group if we were successful with the Zero Dollar Permits. If we are not successful then we will need to pursue the full 18 month Temperary Easement process, which will delay the Letting one year to Fiscal 2009.

3.1 Mapping

Jerome will work with Metro Surveys and Metro GIS to provide any mapping, topo, parcel information, and aerial photos that Becky may need to complete her work.

4.0 Funding

Roger Schultz has funded the construction of this project with Fiscal Year 2008 dollars. If the R/W process delays the project one year we will need to work with Marv Lunceford to figure out how to shift money around from Fiscal Year 2008 to 2009.

5.0 Contractor advice on prosecution of work

Steve Kordosky will arrange meetings with different contractors to ask how they would stage and prosecute the steel reinforcement work. Steve will keep Paul Kivisto and Jerome Adams informed during this process and invite them to any meetings that occur. Steve will work with the office of Innovative Contracting to insure that Mn/DOT follows the proper legal process that documents that Mn/DOT is not showing favoritism to any contractors.

5.1 Length of work

Steve will ask the contractors the length of time they think will be required to complete the job. This information is important to Metro Traffic Control, so this project can be coordinated with the SP 2781-408 TH 94 project. It is currently expected that the TH 94 project will be completed by the end of August, so that it does not conflict with the State Fair and the 2008 Republican National Convention.

6.0 Traffic Control

It would be best to start the bridge work in April or May 2008. This will provide an entire construction season to complete the work should complications arise. It is expected that the work should only take 2 or 3 months. During bridge construction there will be a single axle and multiple axle truck prohibition on the bridge. All other vehicles including buses will be

allowed. The work on TH 94 at TH 280 should not occur at the same time as the work on Br. 9340, because TH 280 will be a truck detour.

We will need to coordinate with the City of Minneapolis on detouring West River Road to make sure the closure does not conflict with schedule marathons or other events.

7.0 Coast Guard

Gary Peterson will initiate contact with the Coast Guard. He will include Don Flemming in any contacts. Gary and Don will work together to satisfy all requirements from the Coast Guard. Ultimately, Don will be responsible to write up the special provisions explaining what the contractor can and can not do in the Mississippi River channel and the paperwork the contractor needs to complete and submit to the Coast Guard.

8.0 Army Corps. of Engineers

Jerome Adams will initiate contact with the Army Corps. of Engineers. He will include Don Flemming in any contacts. Jerome and Don will work together to satisfy all requirements from the Army Corps. of Engineers. Ultimately, Don will be responsible to write up the special provisions explaining what the contractor can and can not do in the Mississippi River channel and the paperwork the contractor needs to complete and submit to the Army Corps. of Engineers.

CC: Marv Lunceford
Roger Schultz
John Griffith
Mike Herman

From: Gary Peterson
To: Vance Desens
Date: Tue, Dec 19, 2006 9:21 AM
Subject: Re: Bridge #9340

Vance, The object of doing UT is to locate the tab plates on certain truss members that do not have shop drawings so that bolting patterns in a subsequent plating contract can be detailed to miss those tab plate locations. On members that do have shop drawings we are confident that the consultant is able to locate the tab plates from the shop drawings and to develop a bolting pattern to miss them.

I put a call into URS asking them to identify the members which did not have shop drawings available for them to locate the diaphragm tab plates. I also asked that if they assumed a member was similar to one that did have shop drawings, to identify that member so we can order the corresponding shop drawing for you. I'll get back to you when I have more information.

>>> Vance Desens 12/19/2006 8:18 AM >>>
Gary:
I am on the Metro Fracture Critical Bridge Inspection team under Mark Pribula. I have been given the project of locating the interior diaphragms of the tension members in the upper chord of Bridge #9340. I-35W over the Mississippi River in Minneapolis.

Per your conversation with Mark, I'm looking for the shop drawings for all the panel points of the upper chord of the deck truss. Do you know where I can find them or do have them? I want to set up a "table" showing the locations for UT testing when we do our 2007 inspection in September.

Thank you,

Vance Desens
Engineering Specialist
Fracture Critical Bridge Inspection
Water's Edge
[redacted]

CC: Don Flemming; Mark Pribula

From: Gary Peterson
To: Todd Niemann
Date: Thu, Dec 21, 2006 4:48 PM
Subject: Fwd: Fw: Retrofit Recommendations

Todd, read the report. Is it feasable to do UT on these 52 members with confidence that we detect existing flaws. I think we are looking primarily at the tab plate diaphragm connection detail within the box.

[redacted]
Gary attached is the recommendation from Ed Zhou regarding the number of members to plate. As you can see from Ed's discussion it all depends on how conservative we want to be with the plating in regard to how many members we plate. I had mentioned in our meeting on December 4th that I thought it would be 40 members and Ed's most conservative number is 52. This difference is mainly my not including the corresponding chord member on the opposing side of a zero force member.

I would be happy to discuss at any time and my goal is that URS and Mn/DOT would reach consensus on the appropriate repair.

Don
----- Original Message -----
From: <Ed_Zhou[redacted]
To: "DFlemming" <dflemming[redacted]
Cc: <Don_Flemming[redacted] <Brett_McElwain[redacted]
<David_Long[redacted]>
Sent: Monday, December 18, 2006 10:47 AM
Subject: Retrofit Recommendations

> Don,
>
> Per our discussions last week, here is the revised retrofit
> recommendations
> where we provide three options for them to pick from.
>
> Ed
>
> (See attached file: Member Retrofit Recommendations.doc)
>

[redacted]

>
>
>
>
>

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 $R_s S_r$	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).

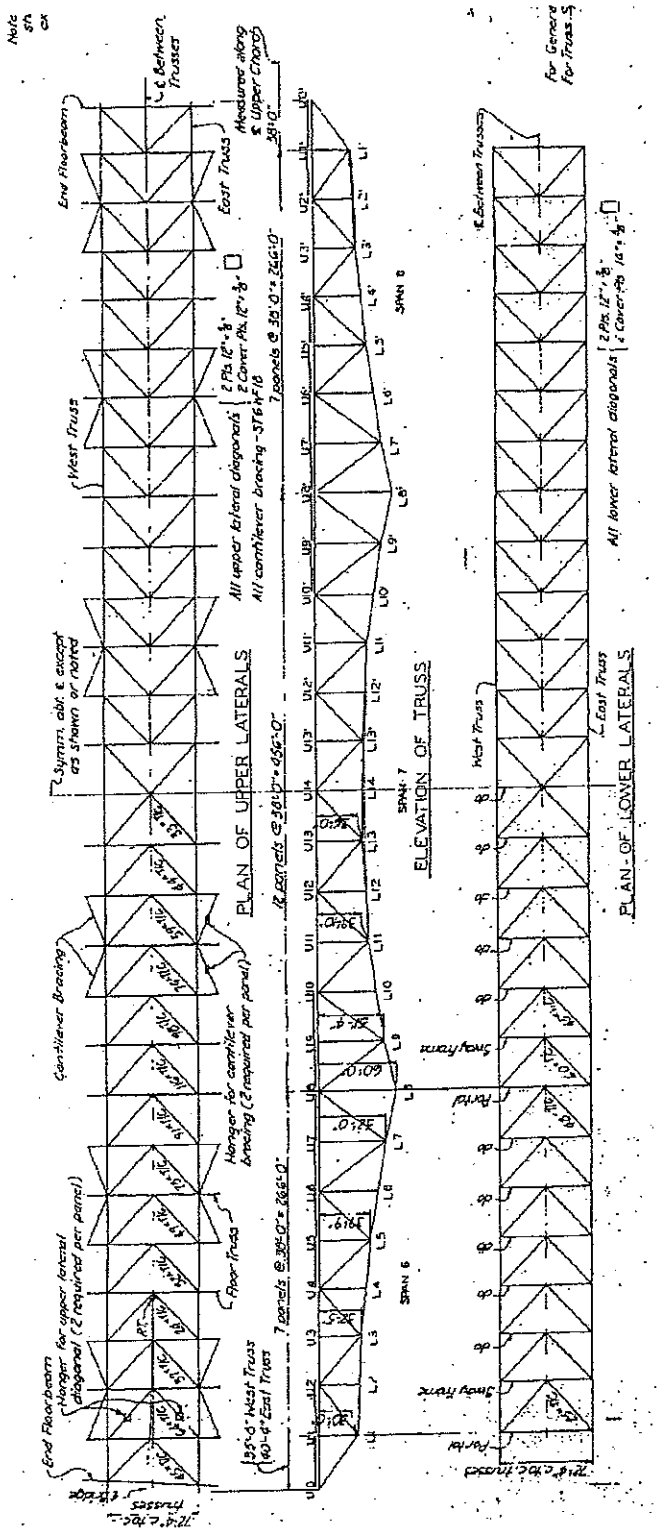


Figure 1: Deck Truss Framing Plan and Elevation from Original Contract Plans (Highlighted Members are Identified Fracture Critical Members)

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: Paul Kivisto
To: tworke[redacted]
Date: Thu, Dec 28, 2006 11:00 AM
Subject: Re: 2008 Steel Plating job on I-35

Tim,
Attached please find a scope of work for the proposed steel plating on Br. #9340, TH 35W over the Mississippi River. If you will be the contact person, please add your name and contact information to the scope and desired date of response. I think you have the electronic version of the plan repair locations and a detail, but if you need any other information please contact Gary Peterson or myself.
Thanks!
Paul

>>> Steve Kordosky 12/22/2006 12:30 PM >>>
Paul,

On the Hwy 36 project, I typed up a 1 page memo describing the work and the goals of a constructibility review for the contractors.

I think this memo would be a good idea on the 35W project, in that the Contractors could drive out to the project with the memo, look around the project thinking about the work, and then meet with us to discuss the project.

Someone with construction background should write it. I prefer that you write it because you are more familiar with the work. If you can, write it and send it to Tim Worke. If you can't let me know and I'll write it.

>>> Gary Peterson 12/20/2006 9:57 AM >>>
Tim, the scan of the bridge GPE sheet does not highlight with color the members we are planning to work on. Note that the members in the end spans of the truss are circled or numbered. In mid span of the main span you'll note about 4 bottom chord members have been thickened. They also will be worked on. In addtion, there may be some members in the top chord located directly over the pier that the consultant is considering adding.

The other sheet is one sheet of several that detail the plates and bolting that constitute the work of the plating project. Note that 100ksi steel and 490 bolts are being used.

Steves previous note to you indicated we would like to talk (or meet with) to a few contractors about this. You might want to check again with Steve before making a lot of work for yourself collecting comments.

>>> "tim worke" [redacted] 12/19/2006 1:42:59 PM >>>
Steve:

We discussed this job at the AGC-MN/DOT Bridge Committee and it was agreed that I would forward information on to both Bridge Contractors and Steel Erectors for comments. I will need some more information form you in order to execute this.

Can you forward me electronically any plan sheets or project description and the questions you would like addressed? Then I will send out and collect the comments and forward back to you.

From: Gary Peterson
To: Paul Kivisto; Steve Kordosky
Date: Tue, Dec 26, 2006 4:11 PM
Subject: Re: 2008 Steel Plating job on I-35

Paul, see my comments in blue. Feel free to modify as you think.

>>> Paul Kivisto 12/26/2006 2:54 PM >>>
Gary and Steve,
Before I send this on to Tim Worke do you have any comments on the attached scope of work?
Paul

>>> Steve Kordosky 12/22/2006 12:30 PM >>>
Paul,

On the Hwy 36 project, I typed up a 1 page memo describing the work and the goals of a constructibility review for the contractors.

I think this memo would be a good idea on the 35W project, in that the Contractors could drive out to the project with the memo, look around the project thinking about the work, and then meet with us to discuss the project.

Someone with construction background should write it. I prefer that you write it because you are more familiar with the work. If you can, write it and send it to Tim Worke. If you can't let me know and I'll write it.

>>> Gary Peterson 12/20/2006 9:57 AM >>>
Tim, the scan of the bridge GPE sheet does not highlight with color the members we are planning to work on. Note that the members in the end spans of the truss are circled or numbered. In mid span of the main span you'll note about 4 bottom chord members have been thickened. They also will be worked on. In addtion, there may be some members in the top chord located directly over the pier that the consultant is considering adding.

The other sheet is one sheet of several that detail the plates and bolting that constitute the work of the plating project. Note that 100ksi steel and 490 bolts are being used.

Steves previous note to you indicated we would like to talk (or meet with) to a few contractors about this. You might want to check again with Steve before making a lot of work for yourself collecting comments.

>>> "tim worke" [redacted] 12/19/2006 1:42:59 PM >>>
Steve:

We discussed this job at the AGC-MN/DOT Bridge Committee and it was agreed that I would forward information on to both Bridge Contractors and Steel Erectors for comments. I will need some more information form you in order to execute this.

Can you forward me electronically any plan sheets or project description and the questions you would like addressed? Then I will send out and collect the comments and forward back to you.

Thanks

Tim Worke
Director, Highway & Transportation Division
Associated General Contractors of Minnesota
[redacted]

Br. #9340
TH 35W over Mississippi River in Minneapolis
Steel Plating Retrofit Work
Steel Deck Truss portion of bridge

Scope of Proposed Work

Mn/DOT intends to let a construction project in late 2007 to retrofit some of the chord members on the steel deck truss on Br. #9340, TH 35W over the Mississippi River. The members have some fatigue prone details that could cause problems if fatigue cracks were to occur. Retrofit work will consist of bolting steel plates to the outside vertical faces of some bottom chord, diagonal, and upper chord members as shown in the attached sketch. The plates will consist of HPS 100W steel ranging in size from ½" x 13.5" x 33' to 1.375" x 13.5" x 33'. The bolts are A490 grade and vary in number based on the member. Expected work is to fabricate the retrofit plates to the dimensions shown in the plans, remove paint and prime the ends of inplace members, position plates adjacent to the inplace member, drill holes into the existing members using new plates as a template, and erect the retrofit plates and tighten fasteners. Plates will be shop primed and the finish coat may be applied in the shop (field touchup required) or in the field. Caulking will be required between the inplace and retrofit plates. The chord members consist of a box shape, and access to the internal portion of the boxes are through handholes that have plastic covers inplace.

Constructability Review

Access for retrofit work will be dependent on contractors preference and will be subject to permits from regulating agencies. Mn/DOT would like to get input from contractors on how they would propose to stage the work, either from above or below the deck. Work would likely take place during summer, 2008. Due to potential conflicts with river navigation, staging in the river in the navigational channel in the vicinity of the Corps of Engineers lock may not be possible. Access on the north and south banks of the river would require closure of frontage roads and permits from private property owners.

Mn/DOT will hold one-on-one meetings with a few contractors and steel erectors to get information on how the project should be staged for a cost effective and safe project. Estimates of fabrication and construction time will also be welcomed. All meetings will be confidential. Interested contractors are encouraged to review the attached sketches and make a site visit if needed to familiarize themselves with the bridge. If you are interested in providing input into Mn/DOT's project development process for this bridge please respond to _____ by _____.

From: "tim worke" [redacted]
Date: Tue, Jan 9, 2007 12:52 PM
Subject: Additional Detail: MN/DOT Steel Bridge (#9340) Retrofit Project - Constructability Input Requested

Attached is some additional detail as provided by MN/DOT.....

Tim,

The contractors may also like to see a sample cross section of the repair. I have attached one generic cross section. Some of the plates will be larger, but the concept will be similar. It also may be good to clarify that in the pdf file you sent with the first message that the darkened areas of the lower chord of the center of the bridge are also areas to be repaired, even though they do not have a corresponding number on that sheet.

Dear AGC of Minnesota Member:

The Minnesota Department of Transportation intends to let a project in late 2007 that would retrofit some of the chord members on the steel deck truss of bridge #9340 (TH I-35 over the Mississippi River in Minneapolis). The Department is looking for feedback and advice from contractors regarding the project staging and constructability aspects of executing this job.

Attached are copies of a memo outlining the specifics of the project scope of work and a cursory plan page that can be used to to become more familiar with the project.

Please direct your interest to the MN/DOT project Manager - Steve Kordosky [redacted] or [redacted] Individual meetings will be set up with prospective bidders to discuss the constructability aspects of the project.

Tim Worke
Director, Highway & Transportation Division
Associated General Contractors of Minnesota
[redacted]

[redacted]

From: "tim worke" [redacted]
Date: Tue, Jan 9, 2007 10:29 AM
Subject: MN/DOT Steel Bridge (#9340) Retrofit Project - Constructability Input Requested

Dear AGC of Minnesota Member:

The Minnesota Department of Transportation intends to let a project in late 2007 that would retrofit some of the chord members on the steel deck truss of bridge #9340 (TH I-35 over the Mississippi River in Minneapolis). The Department is looking for feedback and advice from contractors regarding the project staging and constructability aspects of executing this job.

Attached are copies of a memo outlining the specifics of the project scope of work and a cursory plan page that can be used to to become more familiar with the project.

Please direct your interest to the MN/DOT project Manager - Steve Kordosky [redacted] or [redacted] Individual meetings will be set up with prospective bidders to discuss the constructability aspects of the project.

Tim Worke
Director, Highway & Transportation Division
Associated General Contractors of Minnesota
[redacted]

[redacted]

Br. #9340
TH 35W over Mississippi River in Minneapolis
Steel Plating Retrofit Work
Steel Deck Truss portion of bridge

Scope of Proposed Work

Mn/DOT intends to let a construction project in late 2007 to retrofit some of the chord members on the steel deck truss on Br. #9340, TH 35W over the Mississippi River. The members have some fatigue prone details that could cause problems if fatigue cracks were to occur. Retrofit work will consist of bolting steel plates to the outside vertical faces of some bottom chord, diagonal, and upper chord members as shown in the attached sketch. The plates will consist of HPS 100W steel ranging in size from ½" x 13.5" x 33' to 1.375" x 13.5" x 33'. The bolts are A490 grade and vary in number based on the member. Expected work is to fabricate the retrofit plates to the dimensions shown in the plans, remove paint and prime the ends of inplace members, position plates adjacent to the inplace member, drill holes into the existing members using new plates as a template, and erect the retrofit plates and tighten fasteners. Plates will be shop primed and the finish coat may be applied in the shop (field touchup required) or in the field. Caulking will be required between the inplace and retrofit plates. The chord members consist of a box shape, and access to the internal portion of the boxes are through handholes that have plastic covers inplace.

Constructability Review

Access for retrofit work will be dependent on contractors preference and will be subject to permits from regulating agencies. Mn/DOT would like to get input from contractors on how they would propose to stage the work, either from above or below the deck. Work would likely take place during summer, 2008. Due to potential conflicts with river navigation, staging in the river in the navigational channel in the vicinity of the Corps of Engineers lock may not be possible. Access on the north and south banks of the river would require closure of frontage roads and permits from private property owners.

Mn/DOT will hold one-on-one meetings with a few contractors and steel erectors to get information on how the project should be staged for a cost effective and safe project. Estimates of fabrication and construction time will also be welcomed. All meetings will be confidential. Interested contractors are encouraged to review the attached sketches and make a site visit if needed to familiarize themselves with the bridge. If you are interested in providing input into Mn/DOT's project development process for this bridge please respond to _____ by _____.

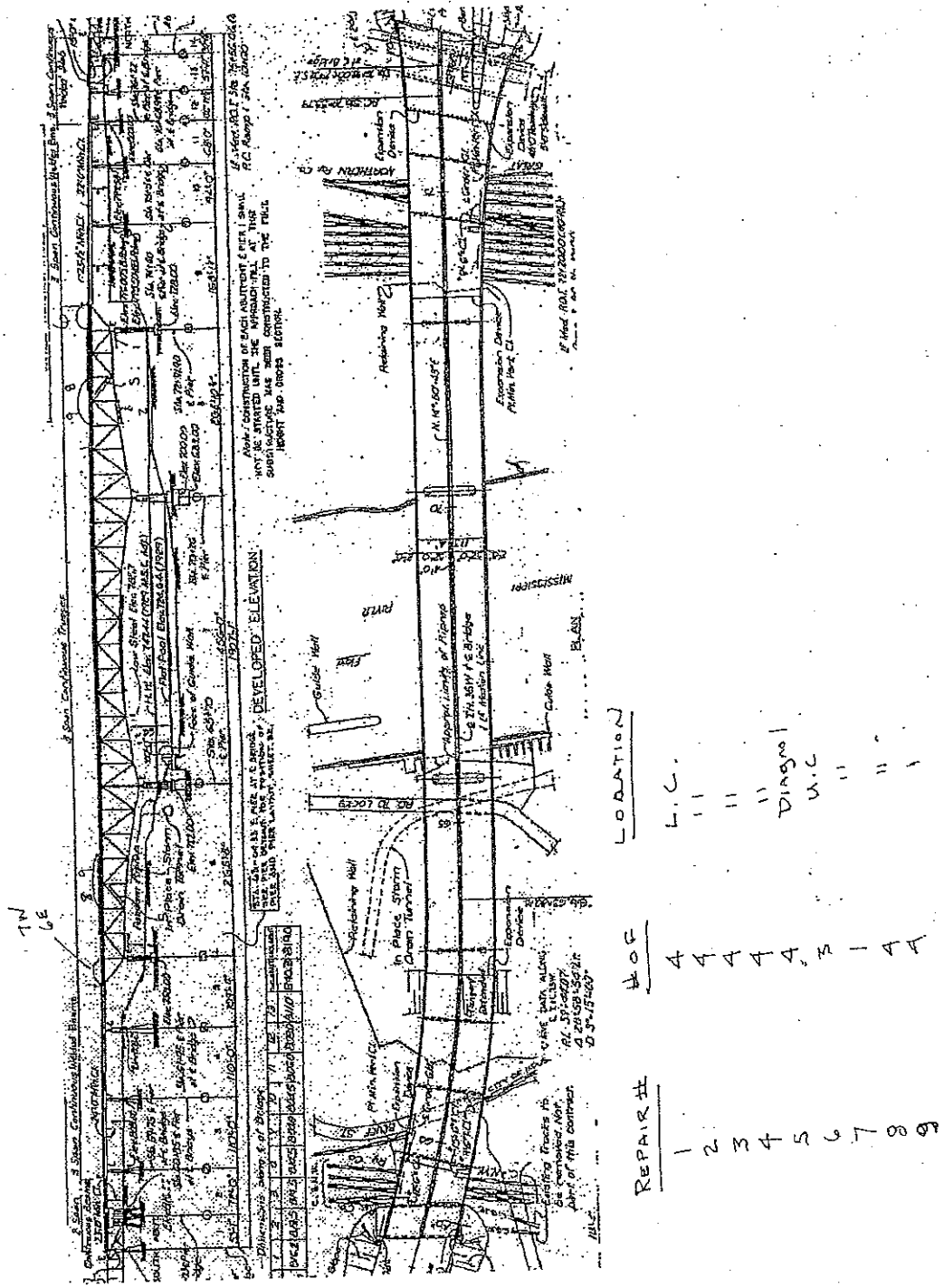
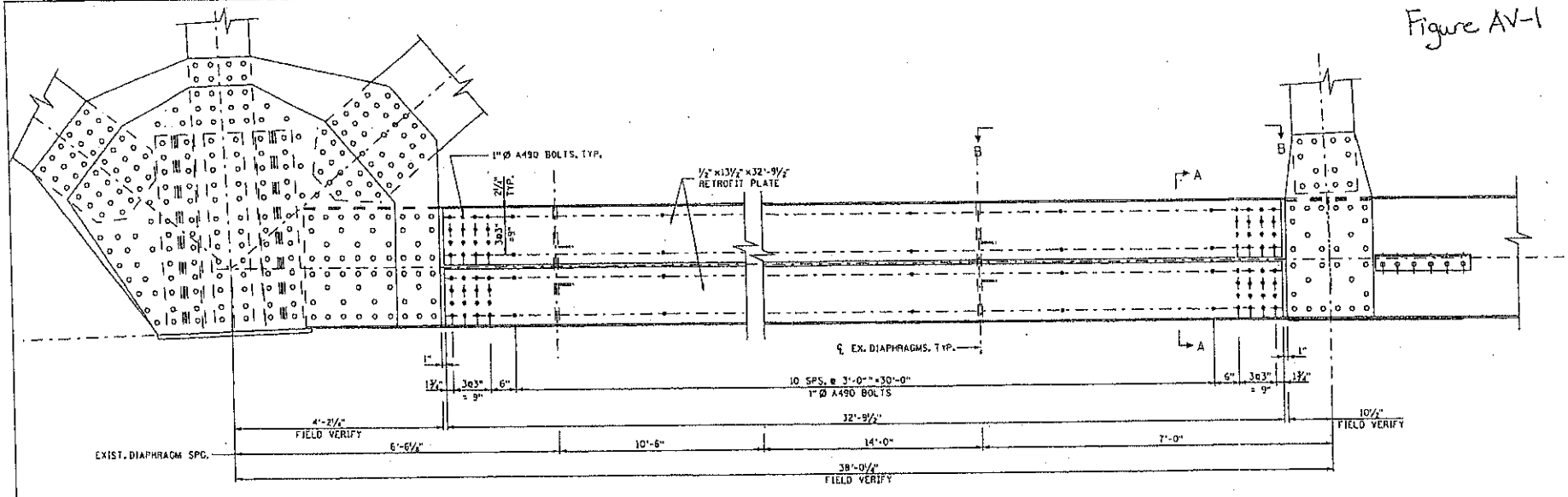


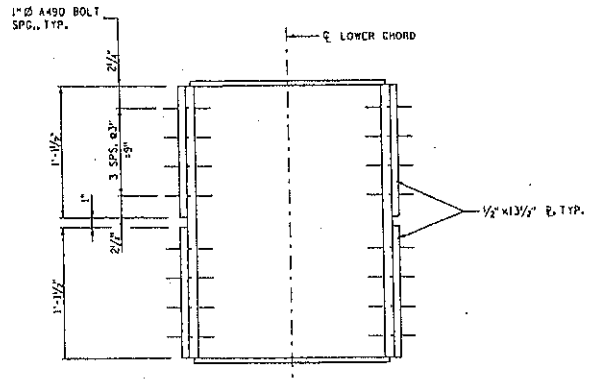
Figure 1-1. Bridge 9340 General Plan and Elevation from Original Contract Plan

Figure AV-1

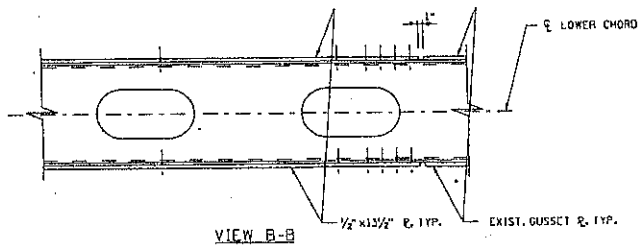


ELEVATION

EAST ELEVATION SHOWN
WEST ELEVATION MIRRORED



SECTION A-A



VIEW B-B

CONSTRUCTION NOTES

THE 2000 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

GENERAL NOTES

PLATE SIZES AND BOLT REQUIREMENTS ARE BASED ON THE ACTUAL CALCULATED TRUSS MEMBER LOADS.

STRUCTURAL STEEL PLATES SHALL BE MPS 100W.

THE YIELD POINT AND ULTIMATE STRENGTH OF THE WELD METAL SHALL BE EQUAL TO OR GREATER TO THE BASE METAL.

FASTENERS SHALL BE A490 AS PER MNDOT SPEC. 3391.2B.

BOLT ALLOWABLE STRESSES ARE BASED ON AASHTO'S VALUES FOR CLASS B CONTACT SURFACE. STANDARD HOLE TYPE.

ALL PLATE BUTT SPLICES SHALL BE FULL BUTT WELDS USING LOW HYDROGEN PROCESS AND SHALL BE GROUND FLUSH AND CONFORM TO SPEC. 2471.3.G.

RETROFIT PLATES SHALL BE SHOP DRILLED WITH 1/8" Ø OVERSIZED HOLES. PLATES SHALL BE LIFTED INTO PLACE AND USED AS A TEMPLATE FOR LOCATING AND DRILLING HOLES INTO EXISTING TRUSS MEMBERS.

CONTRACTOR SHALL FIELD VERIFY LENGTHS OF PROPOSED PLATES AND LOCATION OF EXISTING DIAPHRAGMS PRIOR TO FABRICATION OF PROPOSED PLATES. ANY DIFFERENCES BETWEEN FIELD MEASUREMENTS AND CONTRACT DRAWINGS SHALL BE REPORTED TO THE ENGINEER PRIOR TO FABRICATION.

EACH OF THE INDIVIDUAL RETROFIT PLATES SHALL BE COMPLETELY INSTALLED ONTO THE EXISTING TRUSS CHORDS ONE AT A TIME. THE ENDS OF THE RETROFIT PLATES SHALL BE FULLY ATTACHED AND TIGHTENED PRIOR TO INSTALLATION OF THE INTERMEDIATE STITCH BOLTS.

URS Corporation, 700 Grand Third Plaza, Minneapolis, MN 55415	SIGNATURE: / PRINTED NAME: DAVID O. LONG / DATE: / REG. NO. 24384	TITLE: LOWER CHORD L1 - L2, L1'-L2'	DES: DDL DR: DM CHK: DF CHK: DDL APPROVED: / SHEET NO. 1 OF 9 SHEETS / BRIDGE NO. 9340

T:\32702127\Design\detail_sht\L1-L3.dgn 10:34:50 AM 7/14/2006

D

From: Daniel Dorgan
To: Lisa Gaughan
Date: 1/11/2007 10:44:45 AM
Subject: Fwd: Bridge 9340 plating contract scope of work

please print all of this

Daniel L. Dorgan
State Bridge Engineer
Mn/DOT - Bridge Office
3485 Hadley Avenue North
Oakdale MN 55128-3307
[redacted]

>>> Gary Peterson 1/10/2007 3:42 PM >>>
The Agenda will be first to go over Todds comments (see below) and second to make a recommendation on how the scope of work should be developed for the URS design SA, and subsequent use of NDT to limit proposed additional planting. I've scheduled it for 1/2 hr, but if we run over we can extend 1/2 hour according to your schedules.

As we've discussed, Don has stated in a letter (attached) that some additional areas of plating may need to be added to the recommendations of the URS report. The areas originally recommended were typically the highest fatigue areas (none really meet the fatigue susceptible category), but overall stress in the members was low. Fatigue is the mechanism that would cause existing cracks to grow.

They recently added the more highly stressed members that had very low fatigue stresses which are far below the stress levels needed to support crack growth. Without a mechanism for crack growth, he suggests its possible to eliminate these from the plating contract if a thorough NDT inspection determines flaws that could generate cracks are not present.

He suggests that a similar inspection on the more fatigue prone members (again, none really meet the fatigue susceptible category) might eliminate the need to plate those members.

Don needs to know from us if he should include the cost to design and detail these additional High stress, minor fatigue members in his RFP for this project.

I would initially recommend he does ad them as an extra that we can eliminate, and that we assist metro to do thorough NDT inspections of those newly identified members this spring.

odd Niemann 12/27/06 3:44 PM >>>
Gary,

I have read this report and am available to discuss at your convenience.

I have several comments/questions based on this report (I realize I just have the exectutive summary and it is not intended to be overly detailed).

#1 - Have the details been determined to be a certain Catagory (D or E). This report is not clear.
#2 - The reports discusses the protential for brittle fracture for which the basis is plate size. This is a gross generallity that is inappropriate for a technical report of this importance.
#3 - The material properties of the steel with determine ductile vs brittle behavior. No mention is made.
#4 - The statement: "the dimensions fo preexisting cracks need to be quite large in order to propagate under the traffic load and grow to critical size to induce a brittle fracture of the truss chord web plate."

Again, assuming brittle fracture is inappropriate and the preexisting crack size is not identified.
#5 - Assuming the previous statement is true, a "quite large preexisting crack" is very detectable by current inspection frequencies and techniques. NDT could be added to provide reassurance that cracks are not initiating and propagating.
#6 - NDT is highly capable of finding small defects in plate. We currently scan the underside of flanges plate to look for defects in cover plates welded to the topside of top flanges. This would be very similar technique to scan the outside face of a web plate looking for detects associated with internal connections.
#7 - The report later identifies that the dimensions of preexisting surface cracks need to be at least 1/4 of the web plate in order to grow and subsequently cause member fracture. Is this just the depth of the defect. What about the width? Is it 1/4 depth for entire width of the plate. A defect of this size (1/4 fo web plate) would seem to be highly detectable with visual observation. NDT can be used to further substantiate this condition does not exist with high degree of reliabilitly.
#8 - If accessable, UIT could also be employeed as a technique to improve the fatique catagory and completely rule out the probabilty of crack initation or propagation at these stress levels.

These are just my initial thoughts for your consideration/deliberation. As I have not been involved with this study or any of the past analysis of this structure I am not completely familiar with it. I have also never been under this bridge or involved with an inspection. What I know is mostly a combination of pieces from past office discussions, etc. No need to respond back to this list. We can get together and discuss if I can be of further assistance with this project.

>>> Gary Peterson 12/21/2006 4:48 PM >>>
Todd, read the report. Is it feasable to do UT on these 52 members with confidence that we detect existing flaws. I think we are looking primarily at the tab plate diaphragm connection detail within the box.

>>> "DFlemming" [redacted] 12/19/2006 11:19 AM >>>
Gary attached is the recommendation from Ed Zhou regarding the number of members to plate. As you can see from Ed's discussion it all depends on how conservative we want to be with the plating in regard to how many members we plate. I had mentioned in our meeting on December 4th that I thought it would be 40 members and Ed's most conservative number is 52. This difference is mainly my not including the corresponding chord member on the opposing side of a zero force member.

I would be happy to discuss at any time and my goal is that URS and Mn/DOT would reach consensus on the appropriate repair.

Don
----- Original Message -----
From: <Ed_Zhou [redacted]
To: "DFlemming" [redacted]
Cc: [redacted]; <Brett_McElwain [redacted]
<David_Long [redacted]
Sent: Monday, December 18, 2006 10:47 AM
Subject: Retrofit Recommendations

> Don,
>
> Per our discussions last week, here is the revised retrofit
> recommendations
> where we provide three options for them to pick from.
>

> Ed
>
> (See attached file: Member Retrofit Recommendations.doc)
>

[redacted]

>
>
>

From: "DFlemming" [redacted]
To: <Gary.Peterson [redacted]
Date: 12/19/2006 11:20:58 AM
Subject: Fw: Retrofit Recommendations

Gary attached is the recommendation from Ed Zhou regarding the number of members to plate. As you can see from Ed's discussion it all depends on how conservative we want to be with the plating in regard to how many members we plate. I had mentioned in our meeting on December 4th that I thought it would be 40 members and Ed's most conservative number is 52. This difference is mainly my not including the corresponding chord member on the opposing side of a zero force member.

I would be happy to discuss at any time and my goal is that URS and Mn/DOT would reach consensus on the appropriate repair.

Don
----- Original Message -----
From: <Ed_Zhou [redacted]
To: "DFlemming" [redacted]
Cc: [redacted] <Brett_McElwain [redacted]
<David_Long [redacted]
Sent: Monday, December 18, 2006 10:47 AM
Subject: Retrofit Recommendations

> Don,
>
> Per our discussions last week, here is the revised retrofit
> recommendations
> where we provide three options for them to pick from.
>
> Ed
>
> (See attached file: Member Retrofit Recommendations.doc)
>

[redacted]

>
>
>
>

[redacted]

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 $R_s S_r$	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).

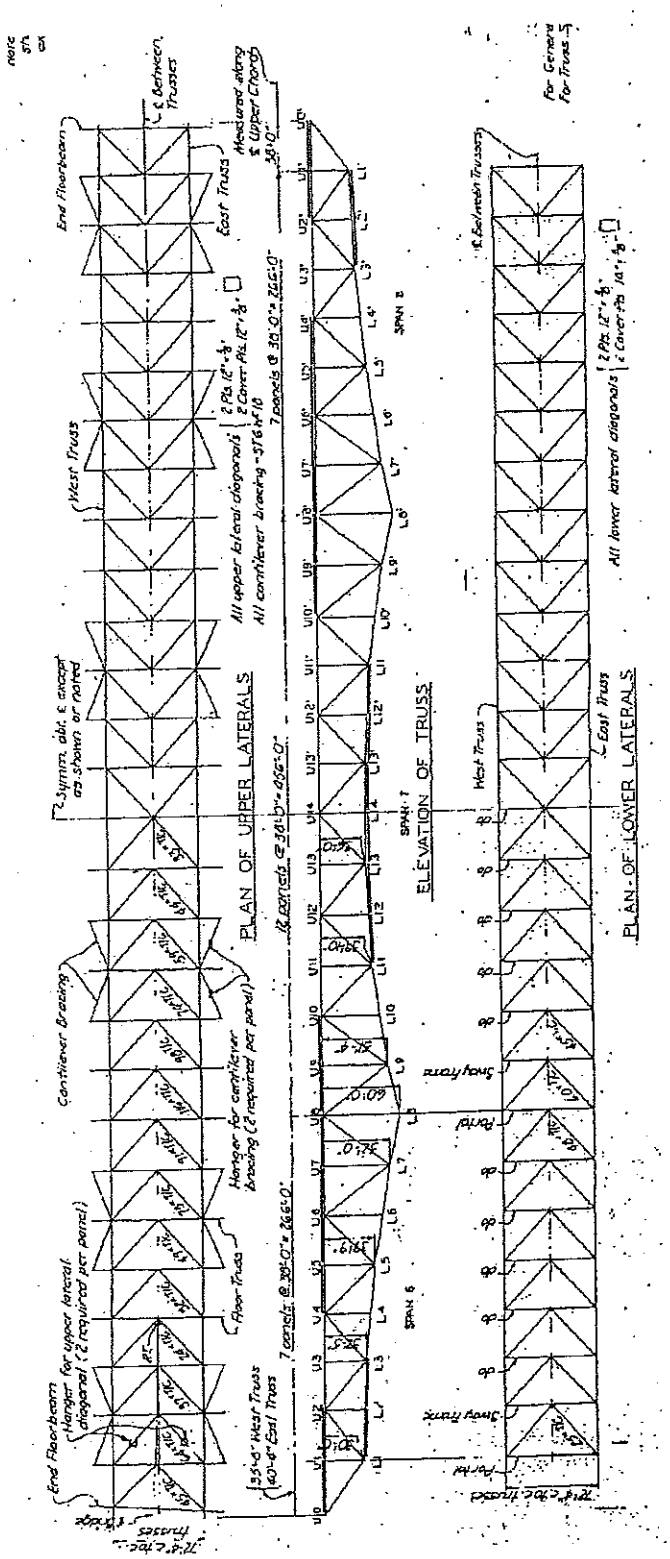


Figure 1: Deck Truss Framing Plan and Elevation from Original Contract Plans (Highlighted Members are Identified Fracture Critical Members)

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
To: Don_Flemming[redacted]
Date: Fri, Jan 12, 2007 5:13 PM
Subject: Re: Conference Call on Bridge 9340

Thanks Don. Dan and Kevin have it scheduled.

>>> <Don_Flemming[redacted] 1/12/2007 5:06 PM >>>

Gary, in regard to the conference call that you requested, Ed Zhou and I could be available on Wednesday January the 17th at 8:30 a.m. I will plan to come to your office for the call as you suggested.

Don

[redacted]

[redacted]

Daniel Dorgan - 9340 plating scope

From: Gary Peterson
To: Bridge Conf Rm 1st Floor; Daniel Dorgan; Kevin Western; Todd Niemann
Date: 1/17/2007
Time: 8:30:00 AM - 9:30:00 AM
Subject: 9340 plating scope
Place: Bridge Conf Rm 1st Floor

Don has confirmed he will be here for an 8:30 Am meeting.

I will be unable to attend. The plan is to have Don come here and to call Ed on conference

Ed - recently did a more detailed review of fatigue, Expect they are Category D using fracture mechanics however some could be "E" due to mfg weld defect or other defects, undercut.

Plating - as long as holes clean after drilling, should not introduce defect.

Defect needs to be 1/4 to 1/3 plate thickness, before crack would propagate under these low stresses.

3 diaphragms each member, 8 tabs per diaphragm only 6 are welded. also look at tack welds.

Decisions:

Do NDE (Evaluation) of South Span where access over parking lot April in 2007. If confident of visual + (over)

ultrasonic testing, proceed with
main & north span.
If not confident, go with
plating repair.

URS - extend contract for time,
plus Ed Zhu support during NDE,
plus plating work (to be deleted
if not used).

From: Gary Peterson
To: Jerome Adams
Date: Thu, Jan 18, 2007 1:36 PM
Subject: Bridge 9340 Plating Project

Jerome, as we discussed, the Bridge Office recently received the attached revision to the consultant's report on fatigue and fracture susceptibility of the truss on bridge 9340. Additional members have been added, above the 32 that we had originally discussed. However the consultant also modified his recommendations to clarify the size of a flaw that would need to be detected during visual or NDT inspection of members. They also clarified that there was no preferred method to address the possibility of collapse resulting from growth of a critically sized weld flaw. Both the plating and NDT inspection options should be effective in minimizing risk, however he cautioned that drilling holes for plate installation may become an issue because drilling could introduce new defects.

The Bridge Office and the consultant discussed the revision at length in a meeting yesterday. The result of the discussion was the Bridge Office believes the plating project planned prior to receiving this revised information may not be necessary. This spring we would like to coordinate with Metro inspection staff to make an in-depth visual and NDT inspection of identified truss members located under the south end of the bridge. If it is determined after the inspection that we are confident welds can indeed be fully inspected and are free of critical sized flaws, the identified members on the remainder of the bridge will be scheduled for in-depth inspection and the plating project will be determined unnecessary. Until that final determination is made we recommend you suspend work on the plating project and postpone possible letting until 2009.

I've talked to Roger Schultz briefly about this delay. My recommendation to him was for him to substitute another project for the 2008 plating project, and that if possible, he should identify some FY 2009 BIP projects that could be postponed if a plating project was deemed necessary to be let in 2009.

We regret the additional work this has caused you and others in the district, but I'm sure you agree that based on this new information its appropriate that we postpone the project until we can determine if another option may as safe and a more cost effective approach.

Call me if you need any additional information or would like to discuss these issues further.

Gary Peterson
Bridge Construction & Maintenance Engineer
Mn/DOT Bridge Office
3485 Hadley Avenue North
Oakdale MN 55128
[redacted]

CC: Daniel Dorgan; Mark Pribula; Paul Kivisto; Roger Schultz; Todd Niemann

Recommendations on Truss Members Retrofit

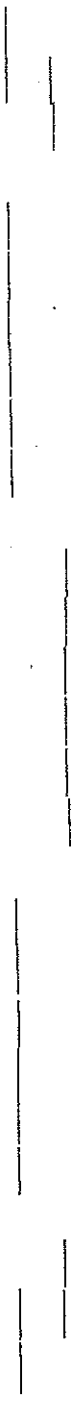
The following table lists the identified 13 fracture critical truss members on one half of each truss. Due to the double symmetry of the deck truss, there are a total of 52 fracture critical main truss members on the bridge structure. Figure 1 shows all the fracture critical members on one truss, or 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 $R_s S_r$	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).



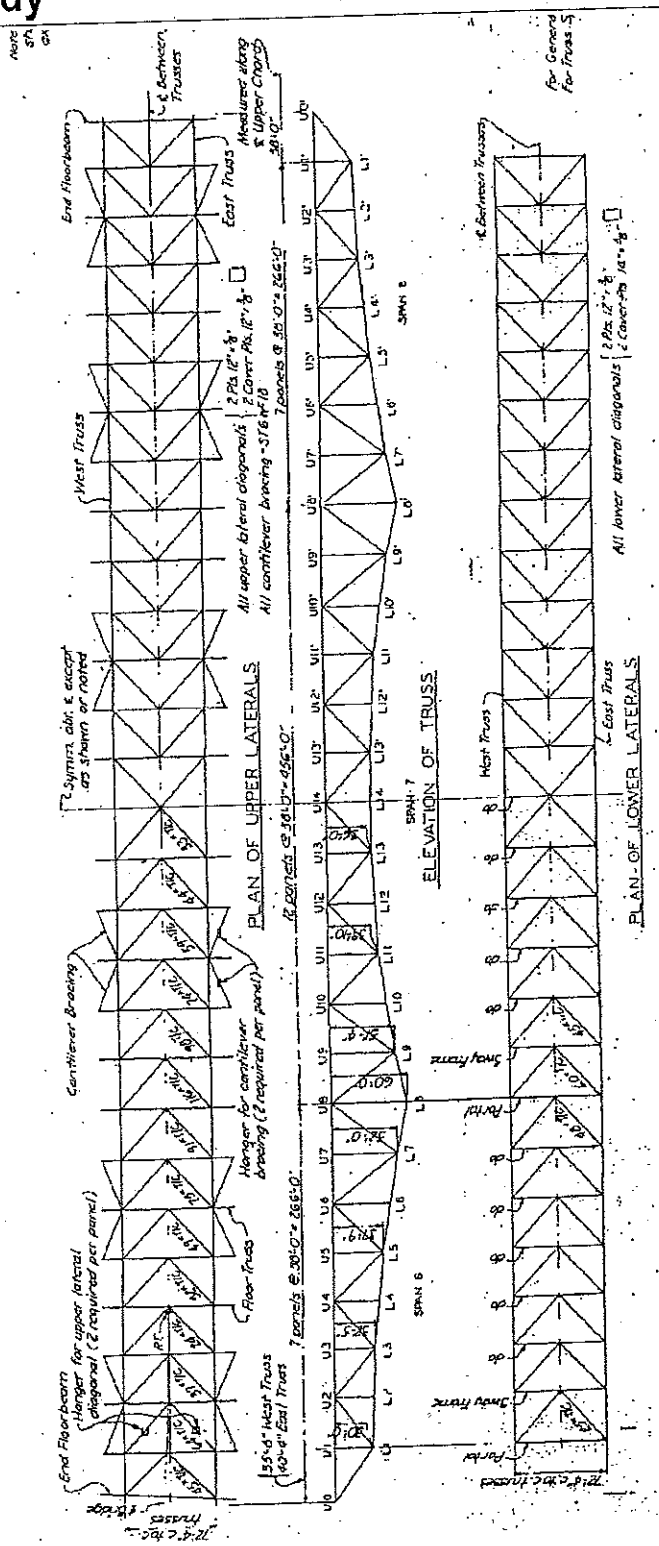

PLAN OF UPPER LATERALS
ELEVATION OF TRUSS
PLAN OF LOWER LATERALS
Cantilever Bracing
Hanger for cantilever bracing (2 required per panel)
Floor Truss
Hanger for upper lateral diagonal (2 required per panel)
End Floorbeam
West Truss
East Truss
All upper lateral diagonals 2 Pls. 12" x ⅜" & 2 Cover Pls. 12" x ⅜"
All cantilever bracing - ST6 WT18
All lower lateral diagonals 2 Pls. 12" x ⅜" & 2 Cover Pls. 14" x ⅜"
Sway frame
Portal
SPAN 6
SPAN 7
SPAN 8

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).