MINNESOTA DEPARTMENT OF TRANSPORTATION (MnDOT)

REPAIR RECOMMENDATION REPORT
BRIDGE NO. 9040

(T.H. 63 over Mississippi River and CP Railway)

RED WING BRIDGE PROJECT

SP 2515-21

HDR Engineering, Inc.

HDR Project No. 177092

January 28, 2013

Section 1 Introduction

1.1 Bridge Description

The Red Wing Bridge (Bridge No. 9040), located near the Town of Red Wing, Minnesota, carries T.H.63 from Minnesota in the southeast, over the CP Railway and the Mississippi River, to Wisconsin in the northwest (Figure 1). The existing structure, constructed in 1958, consists of 9 spans with a total length of 1,631 feet. There are 6 approach spans, with a total length of 767', at the Wisconsin end, which consist of continuous steel multi-beam spans. The main river unit consists of an 864' long, 3-span continuous cantilever steel Warren through truss (Figure 2). The bridge provides the only regional crossing of the river for over 30 miles upstream or downstream for several communities on both the Wisconsin and Minnesota sides of the river.

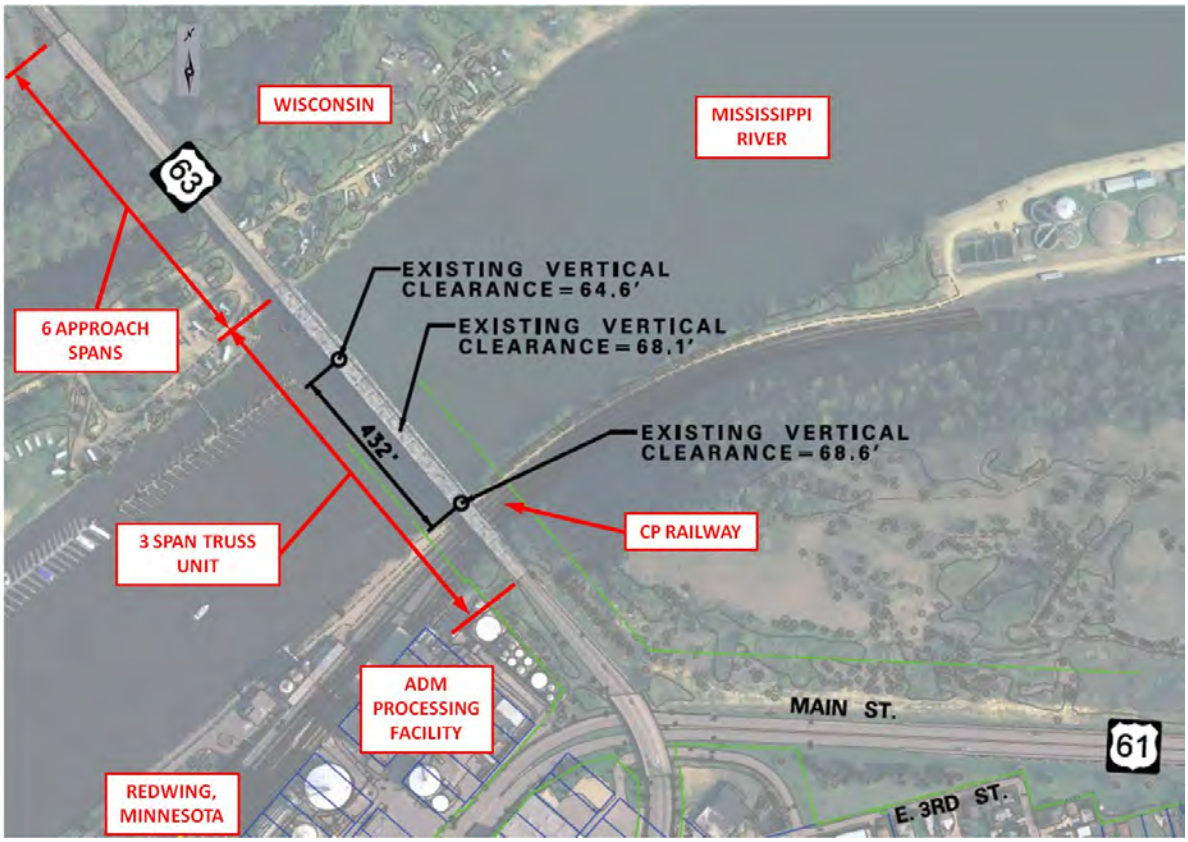


FIGURE 1 – BRIDGE LAYOUT

FIGURE 2 – MAIN TRUSS UNIT ELEVATION VIEW

Additional geometric information for both the truss unit and approaches is provided below:

Main Truss Unit (Spans 1 through 3)

- Span 1 - 6 panels at 36’ = 216’
- Span 2 - 12 panels at 36’ = 432’
- Span 3 - 6 panels at 36’ = 216’
- Center 8 panels (288’-0”) of Span 2 comprise suspended portion of span
- Truss Depth = 38’ (Typical); Haunched to 52’ at Interior Piers
- Center-to-Center Truss Spacing = 39’-11”
- Out-to-Out Deck Width = 37’-4”
- Curb-to-Curb Width = 30’-0”
- Section Information - 1 Lane each direction at 12’-0”; 3’-0” wide shoulders; 2’-6” raised curb on each side; 1’-2” wide traffic barriers on each side

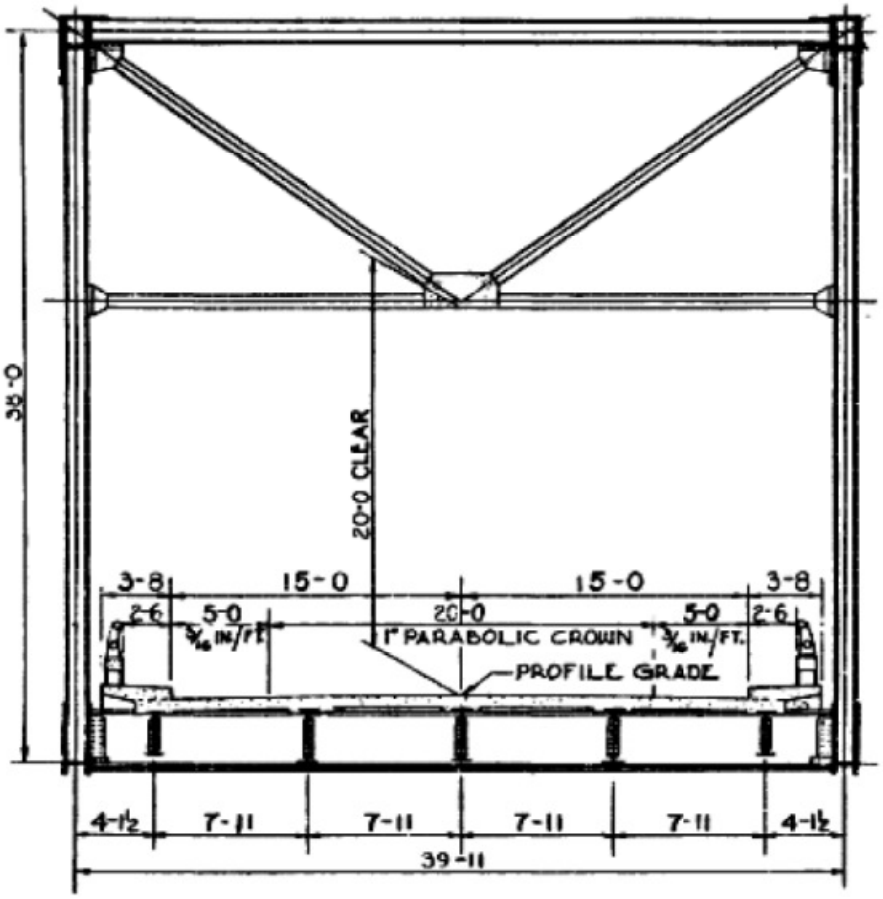


FIGURE 3 – TRUSS TYPICAL SECTION

For each truss line, there are:

- Top Chord Members – 22
- Bottom Chord Members – 24
- Diagonals – 24
- Verticals – 23
- **Total Main Members per Truss Line – 93**
- Top Joint Gussets – 23
- Bottom Joint Gussets – 25
- **Total Main Gussets per Truss Line – 48**

Approach Spans (Spans 4 through 9)

- Spans 4 through 8 are continuous with Pin-and-Hangers located approximately 22’ from piers in Spans 5 and 7 (Figure 4); Built-up plate girders with 60” web plates

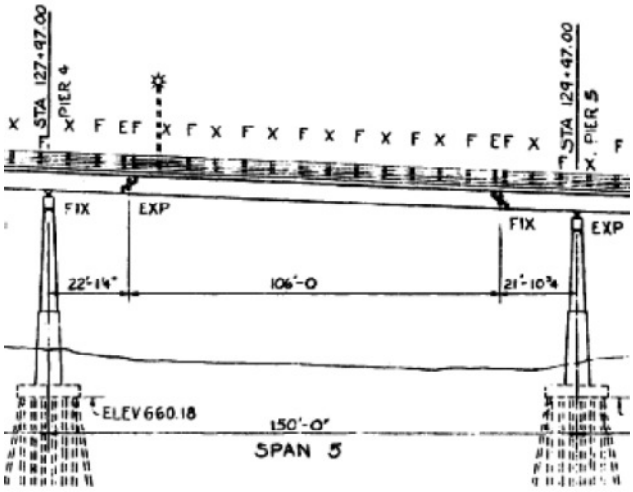


FIGURE 4 – PIN-AND-HANGER LOCATIONS IN SPANS 5 & 7

- Span 4 – 124’ (+)
- Spans 5 through 7 – 150’
- Span 8 – 124’ (+)
- Span 9 – 59’-3” Simple Span; W36X150 Rolled Beams
- Girder Spacing – 4 Spaces at 7’-11” = 31’-8”; 2’-10” overhangs each side
- Out-to-Out Deck Width = 37’-4”
- Curb-to-Curb Width = 30’-0”

- Section Information - 1 Lane each direction at 12'-0"; 3'-0" wide shoulders; 2'-6" raised curb on each side; 1'-2" wide traffic barriers on each side

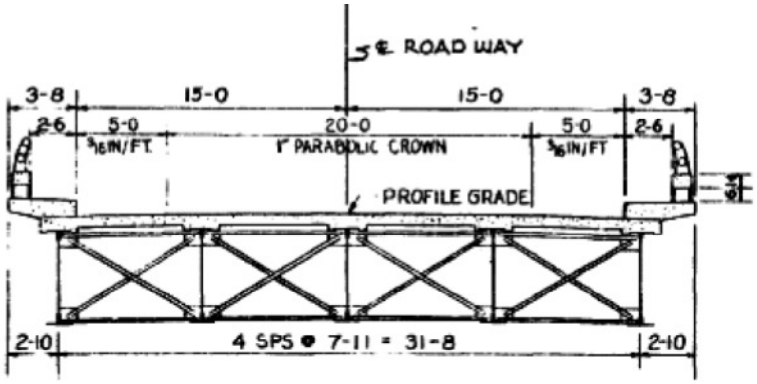


FIGURE 5 – APPROACH TYPICAL SECTION

Main River Span Navigation Clearance (Mississippi River)

- Horizontal Clearance – 421 feet minimum required (421 feet ± existing)
- Vertical Clearance – 64.5 feet above normal pool required (64.5 feet ± existing)
- Normal Pool Elevation – Elevation 667.00 (1912 Datum)
- Design (100-Year) Flood Elevation – Elevation 684.30 (1912 Datum)
- 2% Flowline – Elevation 683.00 (1912 Datum)

  Note: Base on initial coordination with USCG, the existing navigation clearances should be maintained.

Horizontal Clearance

- From centerline of railroad tracks – 25 feet required (25 feet ± existing); the need to provide protection of existing Pier 1 to be determined.

Vertical Clearance

- Roadway - 16'-4" required (NA existing). No existing roadways are overpassed. Clearance over marina parking area significantly greater than 16'-4".
- Railroad - 23'-0" required (51 feet ± existing)
- Portal/through truss clearance - 20'-0" required per MnDOT LRFD Bridge Design Manual (20 feet ± existing)

1.2 Scope of Work

The following is a summary of the Scope of Work provided by MnDOT for the project, the bridge studies in general and this bridge rehabilitation study.

1.2.1 Project Scope

The work associated with the preliminary design phase of the Red Wing Bridge Project includes the US Highway 63 (US 63) Bridge No. 9040 over the Mississippi River and Bridge No. 9103 over US Highway 61 (US 61), as well as the highway connections to US 61, Minnesota Trunk Highway 58 (TH 58), and approach roadways in the State of Wisconsin. The scope of work includes the following components:

1. All tasks necessary to complete scoping and environmental documentation for the bridges, highway connections, and approach roadways, including proposed roadway/route improvements within the City of Red Wing and in the State of Wisconsin (if necessary). An Environmental Assessment (EA) document will be assumed as the basis for beginning preliminary design.

2. All tasks necessary to complete preliminary design for the approach roadways and conceptual study of roadway/route improvements within the City of Red Wing and in the State of Wisconsin (if necessary).

3. All preliminary bridge engineering required to complete preliminary plans and/or bridge type selection for rehabilitation or replacement of Bridge Nos. 9040 and 9103. All preliminary bridge engineering required to complete the bridge type selection for other approach bridges (if necessary), and the location and profile establishment for the design of the approach roadways.

The project team will complete all necessary scoping, project management, public involvement, environmental impact investigation and documentation, traffic engineering, staging considerations, lifecycle cost determination, preliminary geometric layout, value engineering support, and other data collection required to determine a preferred alternative for rehabilitation or replacement of Bridge No. 9040, a preferred alternative for rehabilitation, replacement, or elimination of Bridge No. 9103, and a preferred alternative for the approach roadways/route improvements and bridges in the project area.

In addition, the project team will complete all necessary work to produce a preliminary structure plan for rehabilitation or replacement of Bridge No. 9040 and Bridge No. 9103, a final geometric layout for the approach alignments and a preliminary staging plan for constructing the project. Bridges in the approach roadways will be identified as to length, width, number of spans, and type of structure.

1.2.2 Bridge Feasibility Study and Concept Evaluation Scope

Concurrent with preliminary transportation, social and environmental review, the project team will identify the most promising and practical alternatives for the rehabilitation or replacement of Bridge No. 9040 and rehabilitation, replacement or elimination of Bridge No. 9103.

The project team will conduct a methodical screening of feasible bridge rehabilitation or replacement options, with the goal of establishing a shortlist of the most promising and practical options to be carried forward for more detailed analysis. The project team will identify alternatives which support the project purpose and need with consideration of key project goals and constraints.

This feasibility study will include bridge and project cost estimates along with an assessment of risks. The level of accuracy of the cost estimates will be appropriate for planning-level analysis and decision making.

Note: As part of the initial evaluation of alternatives, various new alignments for the Mississippi River crossing location were considered. These included a crossing immediately adjacent to the existing alignment (to the west), a crossing in the vicinity of Bench Street (County Road 1) to the west of downtown Red Wing, and three alternate crossings at Broad, Bush and Plum Streets in the downtown area. Based on this evaluation, the alternatives with crossings that were not immediately adjacent to the existing location were found to have the following challenges:

Bench Street Challenges:

- Substantial additional wetland and floodplain impacts (in MN & WI)
- Removes the established crossing in the downtown area
- Removes more direct connection to Highway 58
- New crossing in a major bend of the Mississippi River
- Requires additional and longer bridges, increasing costs
- Impacts to the Upper Harbor area

Broad, Bush and Plum Street Challenges:

- Design challenges given navigation requirements near bend in river
- Cross Levee Park and impact downtown historic districts
- Substantial visual/sightline impacts to adjacent buildings
- Extensive wetland and floodplain impacts
- Requires greater bridge length compared to existing bridge

Based on these substantial issues, the decision was made to focus efforts on rehabilitation options or replacement options that were located immediately adjacent to the existing alignment.

1.2.3 Repair Recommendation Report Scope (This Report)

Bridge No. 9040 - Based on the observed condition of the bridge during the field inspection, the safety inspection reports, the bridge ratings and the required typical section to meet the project need, the project team will create a Repair Recommendation Report for the truss and approach spans. The proposed repairs will include an evaluation and recommendation of what is structurally necessary to preserve the existing approach spans versus the complete replacement of the approach spans. The report will summarize the proposed repairs. The draft report will be

submitted to the MnDOT Bridge Office for review. The project team will develop a cost estimate for the entire Bridge Rehabilitation Alternative.

Bridge No. 9103 – This bridge is not included in this report. A separate Repair Recommendation Report will be developed and submitted for this structure.

1.2.4 Project Purpose

As documented in the project's Purpose and Need Statement, the primary purpose of the project is to provide a structurally sound crossing of the Mississippi River and US 61. Secondarily, the project will study future capacity needs and the accommodation of pedestrian/bicycle traffic across the Mississippi River and US 61.

1.2.5 Previously Completed Work

On April 27, 2012, a meeting between the project team and MnDOT personnel was held at the MnDOT office in Oakdale. The purpose of that meeting was to discuss the structural criteria to be used in these analyses, along with the preliminary findings of the structural analyses that were underway (i.e. comparison of preliminary results with previous bridge ratings). The criteria established for the project at that meeting has been included in the project as discussed and is described in Section 3 of this report.

During the week of April 9, 2012, HDR personnel joined MnDOT staff to perform a cursory field inspection of Bridge No. 9040, with the purpose of determining if there were any conditions present on the existing bridge (i.e. member section loss) that should be incorporated into the rating computations. This inspection indicated that there were no areas of appreciable section loss or other conditions that would adversely affect the analyses.

In addition, the following general conditions present on the bridge were noted during the cursory field inspection, during other site visits and/or through a review of previous inspection reports. To aid the reader in identifying the locations indicated in the following discussion (i.e. pier layout, truss joint designations, etc.), a portion of the existing bridge plan set has been included in Appendix H:

Deck and Railings - The deck is cast-in-place concrete, with a low-slump overlay placed in 1978. The upper surface of the deck is in generally satisfactory condition, with some wear showing along the main tire tracks in the traffic lanes. There are scattered areas of light scaling along the north gutter. Scattered transverse cracks are present in the truss spans and approach spans. These cracks have reportedly been sealed. The concrete deck area over the truss section of the bridge is being uplifted slightly due to pack rust along the tops of the floorbeams. There are approximately 1000 to 1500 square feet of unsound or delaminated concrete scattered across the deck surface. Total deterioration of the deck surface is less than 10%. The concrete portions of the railing on both sides have scattered vertical and random cracks with some staining and small rebar spalls. There are numerous small aggregate pop-outs in the concrete rail.

The underside of the deck between the fascia stringers of the truss spans is in generally good condition, with widespread isolated transverse cracks and efflorescence. Isolated small spalls are present near floorbeams in many areas. Spalling is also present in the deck overhang areas outboard of the fascia stringers. In the approach spans, transverse cracks and spalling are more numerous than in the truss spans. Total distressed area is less than 2%.

The concrete curbs and sidewalks are in generally good condition, with minor scattered cracks, spalls and popouts. A larger spall with exposed rebar exists on the west curb near the south abutment.

Deck Joints - There are 16 strip-seal joints on this bridge: nine in the truss span (L2/L2', L4/L4', L6/L6', L10/L10' and L12), four over the pin & hanger and fixed pin hinges in spans 5 and 7, one over Pier 8, and one at each abutment. All joints are filled with dirt and debris but appear to be functioning properly (with no signs of leakage below).

There are 18 transverse poured sawcut joints on the truss and approach spans. All poured joints are in good condition with intact filler material and no evidence of leakage.

There are three finger deck joints on this bridge, located over the hinges at L8/L8' and at the north end of the truss (L0') over pier 3. Joints are in good condition, with fingers in proper lateral and vertical alignment, and minimal deterioration on the underside. There is a 5' long spalled area along the deck surface adjacent to the joint over L8'.

Steel Superstructure - The superstructure elements are in satisfactory condition:

Upper Chords: The upper chords are in good structural condition. The paint has some chalking, as well as discolored areas stemming from paint mix problems during the 2002 repainting. There is some shallow pitting and other surface imperfections in the rolled beams, most likely from original fabrication. There are numerous tack welds between upper chord members and gusset plates, several of which are partly or fully cracked. None of the cracks have propagated into the base metal according to MnDOT's inspection.

Lower Chords: The lower chords are in good structural condition. Like the upper chords, the lower chords have some paint chalking and discoloration. There is isolated paint failure throughout the lower chord, some of these are in the form of corrosion blisters. The west truss built up chord of the suspended span has pack rust up to 1/8" along the top edge of the flange. The bottom truss members on both sides, in Span 2 from L0 to L10, have been sealed with caulk along the top edges. Shallow pitting from the original rolling process is present on many members. Many of the connections between the lower chord and gusset plates have partially and fully-cracked tack welds. None of the cracks have propagated into the base metal according to MnDOT's inspection.

Vertical and Diagonal Members: The vertical and diagonal members are in good structural condition. Condition of the paint is similar to that on the upper and lower chords. There are several areas with minor structural defects such as corrosion, pack rust and small gouges. Finally, cracked tack welds are present between gusset plates and vertical/diagonal members in several locations. None of the cracks have propagated into the base metal according to MnDOT's inspection.

Gusset Plates: Upper gusset plates are in good structural condition, with similar paint issues as previously described for chords and vertical/diagonal members. Half of the lower gusset plates have isolated paint failure or corrosion blisters, generally on the inside plate or inside the panel point. Free edge bowing of up to 1/8" is present on several gusset plates, and appears to be from original construction fit-up. Numerous cracked tack welds are present between upper gusset plates and the top chord, as described previously. None of the cracks have propagated into the base metal according to MnDOT's inspection. Lower gusset plates are also in good structural condition. Bowing of up to 1/8" from original fit-up is present on some gusset plates. Cracked tack welds are present between gusset plates and the lower chord in many locations. At panel points L2W, L6W and L12W, pack rust distortion up to 5/16" is present between the filler shim plates and the diagonal truss members.

Floorbeams: Floorbeams are generally in satisfactory condition, with light to moderate surface corrosion and flaking rust on the top flanges near the truss panel points. All floorbeams were cleaned and repainted in 2002. At many panel points, there is a thick filler plate between the bottom flange of the floorbeam and the lower shelf plate. Significant pack rust distortion is present between the filler plate and shelf plate at some locations, most notably at L6W (1/2" distortion) and L5E (3/8" distortion). Floorbeam FB12 has isolated pitting in the bottom flange at the connection to panel point L12W.

Stringers: Stringers are generally in good condition, with light surface corrosion and rust mainly on the fascia stringers (S1 & S5) near leaking deck joints. All steel stringers were cleaned and repainted in 2002. There are some stringers with scattered areas of minor pack rust along the top flange. Some of the corrosion present on the floorbeam ends is present on fascia stringer upper flanges at these locations. Isolated corrosion of upper flanges is present where stringers run beneath deck joints. Stringers rest in a sliding bearing socket at deck expansion joint locations, and some of these on the fascia stringers have heavy corrosion and flaking rust, most notably at floorbeam FB2.

Approach Girders: All steel girders were cleaned and repainted in 2002. Approach girders in spans 4-9 are generally in good condition, with paint chalking typical of other steel members. Top flange surface corrosion is present in the top flanges near deck joints. There are a few bends in structural components from unknown causes, notably a 3/4" bend in the lower flange of girder 2 in span 5, and in a vertical stiffener on girder 1 in span 8. Neither of these bends is significant enough to cause structural concerns. There are tack welds in the girder vertical stiffeners. Some

of these tack welds are cracked. None of these cracks propagate into the girders according to MnDOT's inspection.

Pin & Hanger Joints: On the truss span, there are pin and hanger joints along the lower chord at panel points L8/L8'. Fretting rust between the nuts and hanger plate indicate movement in the joint. On the lower pin at L8W, the head of the cotter pin appears to be broken off. Based on the previous inspection reports, UT testing produced an indication in each of the lower pins at joints L8'E and L8'W. This indication is 15-17" from the outer pin face, or about half way through the pin. A 50dB signal was needed to see this indication, meaning that it is fairly small. This is most likely an artifact of pin fabrication, where the hole bored lengthwise through the center of the pin was drilled half way from each end. A slight misalignment of the two bores would produce a small "step" in the machined surface. Pin joints at U9/U9' have fretting rust, indicating movement. Based on the previous inspection reports, UT testing of these pins showed no indications.

Approach spans 5 and 7 each have a pin & hanger joints and fixed pin joints. These joints are in good condition, with little or no deterioration. Based on the previous inspection reports, UT testing of all pins showed no indications.

Secondary Structural Elements: Secondary elements include the upper and lower diagonal bracing, sway frames, portal frames and horizontal swivel joints at L8/L8'. Upper diagonal bracing is in good condition, with little or no deterioration. At panel points U3'W and U4'E, some of the rivets connecting the diagonal bracing to the horizontal plates have been replaced with plug welds. The most likely cause is that the pre-drilled holes for these members were missing or misaligned at the time of erection, and plug welds were used instead. No cracks or other weld-related defects were found. Lower diagonal bracing is in good condition, with some minor deterioration at the connection to the truss panel points. Minor pitting is present on some horizontal shelf plates connecting diagonal members to the panel points. Sway frames and portal frames are in good condition, with minor paint deterioration similar to other structural members. Horizontal swivel joints at L8 and L8' are in good condition, with little or no corrosion. Neoprene troughs used to protect swivels from water draining through the finger joints are in place and appear to be functioning properly.

Bearings - The truss span has fixed bearings at either side of the main span (Piers 1 and 2), and expansion rocker bearings at the ends of the truss (South abutment and pier 3). Fixed bearings have light surface corrosion but appear to be functioning properly. Truss rocker bearings also have light surface corrosion, but are functioning properly with remaining expansion capability. The west rocker bearing at the south abutment is missing a retaining collar on the outer end of the pin.

The continuous approach spans (4-8) have fixed bearings at Piers 4, 6 and 7, and expansion rocker bearings at piers 3, 5 and 8. Simple span 9 has fixed bearings at Pier 8 and expansion

bearings at the north abutment. All bearings have light to moderate surface corrosion. The expansion bearings at Pier 8 are at their contraction limit and are no longer functioning. This is probably due to movement of pier 8. Other bearings appear to be functioning properly.

Substructure Elements - The substructure elements are in fair condition:

Abutments: The abutments are in satisfactory condition, with minor cracking, spalling and staining. Some settlement of the north abutment has been reported previously, but no evidence of continued settlement was noted during this inspection. The wingwalls are in good condition, with minor cracking, spalling and staining.

Piers: Piers are generally in satisfactory condition, with specific issues on each pier as described below. At Pier 1, there is a minor spall on the east column below pier cap. There are two transverse cracks in the top of the pier wall. At Pier 2, the columns have large areas of delaminated concrete. Estimated area of unsound concrete is 15 SF at top and 78 SF at bottom of the east column, and 14 SF at top of west column. Spalls with exposed rebar are present at the top of the pier wall and the underside of the pier cap. At Pier 3, unsound concrete is present on south side of east column, and spalls with exposed rebar are on the upper portion of the pier wall. A large diagonal crack is present on the north face of the pier wall. A spall with exposed rebar is present in the pedestal under the northeast truss rocker bearing. At Pier 4, the pier cap is tipped slightly to the south. Measurements on the north face of the cap show 7/16" horizontal tilt over the 4'-11" height of the cap over both columns. At Piers 5 and 6, there have been no significant problems noted. At Pier 7, there is a vertical crack in the pier cap at the west end under the G1 bearing. Pier 8 was braced with steel members in 1972 to control excessive movement and settlement. Extensions to the bearing seats to maintain the original grade were also added at that time. Subsequent inspections have shown that settlement has slowed considerably. In 2009, a check of the raised bearing seats indicated that they were all still plumb. A large spall is present in the north face of the pedestal under the G3 bearing. Cracking in the pedestal is present under the G2 bearing.

Slope Protection: Both abutments have adequate slope protection. There are large washouts at the top of the bluff in front of the south abutment, but these are sufficiently far enough away as to not pose a risk to the abutment.

1.2.6 On-Going (Concurrent) Work

Concurrent with the rehabilitation studies, the project team has been performing an initial screening of new bridge alternative structure types. New bridge alternatives could be built parallel to the rehabilitated existing Bridge No. 9040, with each structure providing two lanes in one direction, or in place of the existing Bridge No. 9040 as a new two-lane or four-lane bridge.

This screening is intended to establish a shortlist of the most promising and practical options to be carried forward for more detailed analysis. This includes identifying alternatives which

support the project purpose and need with consideration of key project goals and constraints. This screening study will be summarized in a memorandum to be submitted to MnDOT in the near future.

1.2.7 Upcoming Work

Following MnDOT review of this Repair Recommendation Report and the New Alternatives Screening Memorandum, the project team will incorporate comments and recommendations, and proceed with a more detailed study of viable new bridge alternatives.

This study will include the development of cost estimates to a reasonable degree of accuracy, along with a determination of potential risks for each of the viable alternatives. This work will culminate with the development and submission of a Bridge Feasibility Study and Concept Evaluation Report, which will be submitted to the Department.

1.3 Organization of this Report

1.3.1 Section 2 – Analysis Approach and Rating Methodology

Section 2 provides a description of the analyses performed for the subject structures including the software used and modeling approach taken. In addition, a general overview of the various rating methodologies utilized to obtain the bridge ratings is provided.

1.3.2 Section 3 – Relevant Design/Evaluation Criteria

Section 3 includes a description of the criteria that were used to develop the structural models, establish the ratings, evaluate the results and develop the preliminary design for recommended repairs.

1.3.3 Section 4 – Load Rating Results

Section 4 provides tabular summaries of the rating results for the various analyses performed.

1.3.4 Section 5 – Required Retrofits

Section 5 contains graphical summaries of components which are predicted to be inadequate for future use (based on the evaluation criteria established for the project) without being retrofitted to provide additional capacity. In addition, Section 5 includes conceptual and representative details of the required retrofits.

1.3.5 Section 6 – Cost Estimate

Section 6 includes cost estimates for various rehabilitation options, along with a basis for the unit costs used in the estimates.

1.3.6 Items Not Included

A list of items not included in this report includes the following:

- Studies (i.e. analysis, repair, historical investigations, etc.) related to Bridge 9103
- Analysis models and output – To be submitted upon request
- Complete structural calculations – To be submitted upon request

Section 2 Analysis Approach and Rating Methodology

2.1 General Discussion – Truss Spans

Classical truss design procedures (which appear to have been used for the design of this bridge, consistent with the era of design) utilized 2D analyses to determine the anticipated forces in the truss members and gusset plates. These analyses included a 2D analysis of the primary truss members in the plane of one truss, and assumed that these primary members would carry the primary (dead and live) loads. Primary members would be subject to the secondary forces, as evidenced by the wind loads shown on the original stress sheet for this bridge. These secondary (wind) forces in the primary members were often determined by performing separate 2D analyses for the framing in the plane of the top and bottom chords. Typically, however, the magnitude of these secondary forces in the primary members (when compared to dead and live load forces) along with the prescribed load combinations (which in ASD design have different allowable stresses) would not typically control the design of the members. When they did control, the design of the primary members would include their effect.

The secondary truss members (bracing) would carry only secondary forces (such as wind), determined from the 2D analyses in the planes of the top and bottom chords. Floor system members (stringers and floorbeams) were designed using 2D line girder type analyses.

Based on past experience, we have determined that the use of a 3D model to determine member forces in the primary members of trusses may lead to unconservative results, or results that aren't consistent with the original design methodology. This results from the fact that the deck and bracing members which are included in the 3D model carry a portion of the DL and LL, and tend to show greater load sharing between truss lines than would be predicted using lever-rule distribution factors. While a 3D model may predict slightly lower forces in the primary members, it is likely not prudent to count on the secondary members to resist primary loads, since they weren't designed for such forces.

This topic was discussed at the meeting held at the MnDOT office in Oakdale on April 27, 2012. At that meeting, MnDOT stated that they had observed similar behavior in previous truss analyses. The decision was made that in general, 2D analyses for the various truss rehabilitation/modification schemes would conservatively be used to determine member forces in the floor system and primary truss members, which would be used to determine load ratings for the truss. However, it was decided that several 3D analyses would be run to confirm the anticipated behavior and assess the magnitude of the force reduction in the primary truss members.

2.2 Description of Truss Analyses

At the April 27, 2012 meeting, the analyses that would be necessary to adequately assess the viability of retaining and possibly modifying the existing truss were discussed. It was determined that analyses of the truss were needed: in the existing condition; with a new deck system (of

similar overall width as the existing deck but possibly with a different configuration); and with a new deck system and some form of new, wider (likely cantilever) sidewalk to better accommodate pedestrian/bicycle traffic. Depending on traffic studies and a decision on the number of future lanes that should be provided, a rehabilitated or modified version of the existing truss could be utilized by itself or in combination with a new, parallel structure.

Based on direction from MnDOT, ratings for the existing condition would be based on the LFD rating methodology, while all future (rehabilitated/modified) condition ratings would be based on the LRFR rating methodology. A more detailed discussion of the different rating methodologies is provided in Section 2.6.

Based on these discussions, the project team developed a matrix of various analyses that might need to be performed. This table of analyses was submitted to MnDOT on May 29, 2012, and is provided in Appendix A.

Shown below in black text are brief descriptions of each analysis along with the purpose of the analysis. Shown in red text are observations and general results and/or adjustments that were made to the analyses throughout the course of the studies:

Analysis 1 – A 2D analysis using geometry, member configuration and loadings consistent with the original design. This would be a baseline analysis to confirm that member force results similar to those reported on the original design drawings were obtained. Analysis 1 showed good correlation between the new 2D analysis and the member forces shown on the original design drawings. Results for this analysis are not included in this report.

EXISTING CONDITIONS:

Analysis 2 – A 2D analysis of the existing condition. This analysis would be used to determine LFD ratings for the existing bridge. Analysis 2 was run and results are provided later in this report.

Analysis 3 – A 3D analysis of the existing condition. This analysis would be used to determine LFD ratings that would be compared to the ratings determined recently by another consultant using a 3D analysis, and to assess the differences between a 2D and 3D analysis (by comparing results to Analysis 2). Analysis 3 was run and results are provided later in this report. The 3D forces from the other consultant's analysis are also provided along side the Analysis 3 results. In general, the 3D analysis showed some decrease in truss chord DL and LL forces (varying from 0% to 20%), when compared to the 2D analysis. The magnitude of the decrease was generally appreciably less for the vertical and diagonal members, and in some cases the 3D analysis showed an increase in forces for these members. In general, there were some numerical differences between the Analysis 3 and the 3D analysis conducted by the other consultant (varying from 0% to 10%), however, in the majority of members, the difference was on the smaller end of this range.

NEW DECK SYSTEM:

Analysis 4 – A 2D analysis with a new conventional (normal weight) concrete deck. This analysis would be used to determine LRFR ratings. This option would represent the minimum scope of a rehabilitation, and the simplest, most conventional and lowest cost type of new deck. Analysis 4 was run and results are provided later in this report.

Analysis 5 – A 2D analysis with a new lightweight deck (such as an exodermic deck). This analysis would be used to determine LRFR ratings. This option would represent the minimum scope of a rehabilitation, and a type of new deck that, while less conventional and likely more costly, would reduce dead loads in the primary truss members when compared to a conventional deck, and improve ratings. Analysis 5 was run and results are provided later in this report.

Analysis 6 – A 2D analysis with a new lightweight deck (such as an exodermic deck). This analysis would assume that 3 lanes of live load would be permitted on the structure. This condition could only occur with a configuration that has no shoulders and lanes narrower than 12 feet. While this condition would be undesirable, it could be used to provide additional traffic capacity. This analysis would be used to determine LRFR ratings. This option would represent the minimum scope of a rehabilitation, and a type of new deck that, while less conventional and likely more costly, would reduce dead loads in the primary truss members when compared to a conventional deck, and improve ratings. Analysis 6 was run and results are provided later in this report.

Analysis 7 – A 3D analysis with a new conventional (normal weight) concrete deck. This analysis would be used to determine LRFR ratings. This option would represent the minimum scope of a rehabilitation, and the simplest, most conventional and lowest cost type of new deck. It would be used to assess the differences between a 2D and 3D analysis (by comparing results to Analysis 4). Analysis 7 was run and generally showed similar 3D effects as described for Analysis 3, when results were compared to Analysis 4. Results for this analysis are not included in this report, as the 2D analyses are used as the basis for the rehabilitation recommendations, as directed by MnDOT.

Analysis 8 – A 3D analysis with a new conventional (normal weight) concrete deck similar to Analysis 7. For this analysis, the number of transverse joints in the deck would be reduced to determine the effect on the distribution of loads within the system. This analysis would be used to determine LRFR ratings. This option would represent the minimum scope of a rehabilitation, and the simplest, most conventional and lowest cost type of new deck. Analysis 8 was run and showed that as the number of deck joints was decreased, the 3D effects were magnified, when compared to Analysis 7. This analysis is also being used to assess the impact of eliminating joints above the floorbeams. Results for this analysis are not included in this report, as the 2D analyses are used as the basis for the rehabilitation recommendations, as directed by MnDOT.

Analysis 9 – A 3D analysis with half of a new conventional (normal weight) concrete deck. This analysis would be used to determine the effect on the trusses of staged construction. The maximum member forces from this analysis would be compared to the other analyses to determine if this construction case would control. One lane of traffic would be placed on the portion of the deck which was present (simulating alternating one-lane traffic). Analysis 9 was run and results are provided later in this report.

NEW DECK SYSTEM AND NEW SIDEWALK

Analysis 10 – A 2D analysis with a new conventional (normal weight) concrete deck and a new 6' wide cantilever sidewalk on each side of the bridge. This analysis would be used to determine LRFR ratings. This option would represent the simplest, most conventional and lowest cost type of new deck, and the narrowest new sidewalk option that could be imposed on each truss line. Analysis 10 was run and results are provided later in this report. Also, an additional analysis, 10A, was added. This analysis is similar to 10, except the LL used was HS20 instead of HL93 and LFR ratings were computed rather than LRFR ratings. This analysis was intended to demonstrate the practical difference between the two methodologies for this bridge.

Analysis 11 – A 2D analysis with a new conventional (normal weight) concrete deck and a new 10' wide cantilever sidewalk on one side of the bridge. This analysis would be used to determine LRFR ratings. This option would represent the simplest, most conventional and lowest cost type of new deck, and the effect of a wider new sidewalk. This analysis would only be made if Analysis 10 (6' wide sidewalk) showed the need for minimal truss repairs/strengthening. Analysis 11 was not run at this time, due to the fact that there were numerous member retrofits necessary for the 6' cantilever sidewalks, and the local and global effects of the 10' sidewalk would be significantly worse.

Analysis 12 – A 2D analysis with a new lightweight deck and a new 6' wide cantilever sidewalk on each side of the bridge. This analysis would be used to determine LRFR ratings. This option would represent a type of new deck that, while less conventional and likely more costly, would reduce dead loads in the primary truss members when compared to a conventional deck, and improve ratings when compared to Analysis 10, and the narrowest new sidewalk option that could be imposed on each truss line. Analysis 12 was run and results are provided later in this report. Also, an additional analysis, 12A, was added. This analysis is similar to 12, except the LL used was HS20 instead of HL93 and LFR ratings were computed rather than LRFR ratings. This analysis was intended to demonstrate the practical difference between the two methodologies for this bridge.

Analysis 13 – A 2D analysis with a new lightweight deck and a new 10' wide cantilever sidewalk on one side of the bridge. This analysis would be used to determine LRFR ratings. This option would represent a type of new deck that, while less conventional and likely more costly,

would reduce dead loads in the primary truss members when compared to a conventional deck, and improve ratings when compared to Analysis 11. This analysis would only be made if Analysis 12 (6' wide sidewalk) showed the need for minimal truss repairs/strengthening. Analysis 13 was not run at this time, due to the fact that there were numerous member retrofits necessary for the 6' cantilever sidewalks, and the local and global effects of the 10' sidewalk would be significantly worse.

Analysis 14 – A 3D analysis with a new lightweight deck and a new 6' wide cantilever sidewalk on each side of the bridge. This analysis would be used to determine LRFR ratings. It would be used to assess the differences between a 2D and 3D analysis (by comparing results to Analysis 12). Analysis 14 was run and generally showed similar 3D effects as described for the other 3D analyses, when results were compared to Analysis 12. Results for this analysis are not included in this report.

Analysis 15 – A 3D analysis with a new lightweight deck and a new 10' wide cantilever sidewalk on one side of the bridge. This analysis would be used to determine LRFR ratings. It would be used to assess the differences between a 2D and 3D analysis (by comparing results to Analysis 13). This analysis would only be made if Analysis 13 was performed. Analysis 15 was not run at this time, due to the fact that there were numerous member retrofits necessary for the 6' cantilever sidewalks, and the local and global effects of the 10' sidewalk would be significantly worse.

FINAL RUNS (TO BE PERFORMED AT A LATER TIME)

Analysis 16 – A final 2D analysis for the preferred rehabilitation alternative to address comments and adjustments made throughout the evaluation process. This analysis would be performed at a future time to support preliminary design. Analysis was not run at this time.

Analysis 17 – A final 3D analysis for the preferred rehabilitation alternative to address comments and adjustments made throughout the evaluation process. This analysis would be performed at a future time to support preliminary design. Analysis was not run at this time.

2.3 Truss Modeling

For the 2D analyses listed previously (Analyses 1, 2, 4, 5, 6, 10, 10A, 12, 12A), a computer model was developed in the software program BAR7 to determine the dead load and live load forces in the primary truss members. The model included only the primary truss members. The structure dead loads were applied to the model as panel concentrations. In BAR7, members are modeled as "truss" members (axial load only). Our experience has indicated that using "frame" type members in such models has little effect on the load distribution in the system. For the 2D model, lateral distribution of live load is handled through the use of live load distribution factors (LLDF's) calculated using the lever rule.

The dead and live load forces from this analysis formed the basis of the primary member and

gusset ratings. The member dead and live load forces obtained from the BAR7 analyses were utilized outside of the program to determine LFR or LRFR ratings. The individual member capacities were then computed through hand computations and the use of spreadsheet tools. These capacities along with the forces obtained from the BAR7 analyses were then imported into spreadsheets which factored the forces for both the inventory and operating levels and calculated the corresponding rating factors.

For the 3D analyses listed previously (Analyses 3, 7, 8, 9), a computer model was developed in the general analysis software program LARSA 4D to determine the dead load and live load forces in the primary truss and floorsystem members. The model included all primary and secondary truss and floorsystem members, along with the deck slab. All members were modeled using "frame" elements and the deck was modeled using "shell" elements. For the 3D model, the structure dead loads were applied through the use of accurate section properties, material densities and application of the "selfweight" command, to determine dead load effects. All truss and floor system member cross-sections where modeled using LARSA Section Composer. This module has the capability of modeling built-up sections that are exported to LARSA 4D for the analysis. For the live load analysis, worst case member forces (both tension and compression) for the defined live load cases were determined using the "moving load" generator in LARSA 4D. For all of the live load cases, influence surfaces for each truss member were developed through the application of unit panel concentrations over the entire deck surface. For LFR, these influence surfaces were then assessed to determine the worst case effect (both tension and compression) for lane load which was compared to the worst case truck load effect to determine the overall worst case live load effect for each member. Similarly, for LRFR, the influence surfaces were used to compute and determine the controlling cases between the HL93 truck and HL93 tandem load cases. Based on the loaded length that controlled for each member appropriate impact factors were also applied.

The dead and controlling live load forces from these analyses formed the basis of the primary member and gusset ratings for the 3D analyses. As with the 2D analyses, the individual member capacities were computed through hand computations and the use of spreadsheet tools. These capacities along with the forces obtained from the LARSA 4D analyses and supplemental influence surface application were then imported into spreadsheets which factored the forces for both the inventory and operating levels and calculated the corresponding rating factors.

Actual load ratings have been calculated only for the bridge's primary members, that include the floorsystem (stringers and floorbeams) and main truss members, and the main gusset plates (those connecting main truss members). It should be noted that the hangers and pins were not rated for the various options in this study, since previous analyses have shown that their ratings are much higher than the other truss components and do not control. As previously stated, these analyses assume that secondary members carry only secondary (i.e. wind) loads. Per MnDOT direction, these secondary load effects were not to be included in the analyses at this level of development. Therefore, the secondary members and connecting plates have not been evaluated.

During a later phase of the project, if rehabilitation options are advanced, these components should be evaluated for adequacy in terms of performance ratios (i.e. capacity / maximum anticipated loads).

2.4 Description of Approach Span (Spans 4 through 9) Analyses

As previously described, the approach spans consist of a 5-span continuous plate-girder unit with pin and hangers (Spans 4 through 8), and a short rolled-beam simple span (Span 9). For these studies, analyses were performed for Spans 4 through 8 only. As determined in previous rating analyses for the approaches, Span 9 did not control.

In addition, based on these previous analyses and discussions with MnDOT, it was apparent that for the existing condition, the main girders in Spans 4 through 8 with existing pin-and-hangers were not rating satisfactorily and should be retrofitted (pin-and-hangers in Spans 5 and 7 eliminated and girders strengthened) or replaced.

It should be noted that the analyses below assume that a new concrete deck of similar width will be constructed as part of the rehabilitation of the approaches. The addition of a widened deck section to accommodate a wider pedestrian/bicycle walkway(s) was not included in the analysis of the girders. It has been assumed that if such a walkway(s) is required, it will be accommodated through the addition of a new fascia girder(s) which will span from pier to pier and support the walkway(s). These new girders would be supported on widened existing pier caps or independently on new single columns and foundations.

The following are brief descriptions of each analysis along with the purpose of the analysis:

Analysis 1 - Existing Girders Made Fully Continuous – A 2D line-girder type analysis of the girders using the existing girder section properties. For this analysis, it was assumed that the pin-and-hangers have been replaced by a bolted girder splice, and the girders are fully continuous for 5 spans. This would be a baseline analysis to determine the new load distribution within the girder and to determine ratings prior to girder strengthening.

Analysis 2 - Continuous Girders Strengthened – A 2D line-girder type analysis of the girders using increased section properties. The increase in section properties at locations where inadequate ratings were predicted by the previous analysis were iterated until acceptable ratings were obtained.

2.5 Approach Modeling

The continuous steel multi-beam approach spans (Spans 4 through 8) load rating analyses were performed using two different software packages which perform line-girder type (2D) analyses. Analysis 1 was performed using the AASHTO software program BRASS GIRDER LRFD V2.0 (VIRTIS). Analysis 1 was re-created in the software package, STLRFD V2.0.0.3, and a comparison of results of the two programs showed very good correlation. STLRFD was then used for Analysis 2 due to ease of use in the iteration process.

At this time, ratings have only been computed for the design live load (HL93). If it is determined that proceeding with rehabilitation of the approach spans is desirable, the precise limits and degree of strengthening required to produce acceptable ratings for the permit vehicles will need to be determined. However, increases (if any) in the amount and limits of strengthening material to be added are not anticipated to be significant and should not appreciably affect the cost of the repairs estimated later in this report and described in Section 5 (It should be noted that a qualitative comparison of the HL93 loading and the permit vehicles was made using influence lines for the approach spans to arrive at this conclusion).

2.6 Rating and Evaluation Methodology

Based on direction from MnDOT, ratings for the existing condition are to be based on the LFR rating methodology, while all ratings computed for future (rehabilitated/modified) conditions would be based on the LRFR rating methodology.

2.6.1 LFR Ratings

Based on the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011, Section 6B.4, the general form of the LFR Rating Equation is defined as:

$$RF = \frac{C - A_1 D}{A_2 L(1+I)} \qquad (6B.4.1\text{-}1)$$

where:

RF = The rating factor for the live load carrying capacity. The rating factor multiplied by the rating vehicle in tons gives the rating of the structure (see Eq. 6B.4.1-2)

C = The capacity of the member (see Article 6B.5)

D = The dead load effect on the member (see Article 6B.6.1). For composite members, the dead load effect on the noncomposite section and the dead load effect on the composite section need to be evaluated when the Allowable Stress method is used

L = The live load effect on the member (see Article 6B.6.2)

I = The impact factor to be used with the live load effect (see Article 6B.6.4)

A_1 = Factor for dead loads (see Articles 6B.4.2 and 6B.4.3)

A_2 = Factor for live load (see Articles 6B.4.2 and 6B.4.3)

A_1 and A_2 vary depending on the desired rating level (inventory or operating)

For:

Inventory Level Ratings (IRF), $A_1 = 1.3$ and $A_2 = 2.17$

Operating Level Ratings (ORF), $A_1 = 1.3$ and $A_2 = 1.3$

2.6.2 LRFR Ratings

Based on the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011, Section 6A.4, the general form of the LRFR Rating Equation is defined as:

$$RF = \frac{C - (\gamma_{DC})(DC) - (\gamma_{DW})(DW) \pm (\gamma_P)(P)}{(\gamma_{LL})(LL + IM)} \qquad (6A.4.2.1\text{-}1)$$

For the Strength Limit States:

$$C = \varphi_c \varphi_s \varphi R_n \qquad (6A.4.2.1\text{-}2)$$

Where the following lower limit shall apply:

$$\varphi_c \varphi_s \geq 0.85 \qquad (6A.4.2.1\text{-}3)$$

For the Service Limit States:

$$C = f_R \qquad (6A.4.2.1\text{-}4)$$

where:

RF = Rating factor

C = Capacity

f_R = Allowable stress specified in the LRFD code

R_n = Nominal member resistance (as inspected)

DC = Dead load effect due to structural components and attachments

DW = Dead load effect due to wearing surface and utilities

(Continued on Next Page)

P = Permanent loads other than dead loads

LL = Live load effect

IM = Dynamic load allowance

γ_{DC} = LRFD load factor for structural components and attachments

γ_{DW} = LRFD load factor for wearing surfaces and utilities

γ_p = LRFD load factor for permanent loads other than dead loads = 1.0

γ_{LL} = Evaluation live load factor

φ_c = Condition factor

φ_s = System factor

φ = LRFD resistance factor

Table 6A.4.2.3-1—Condition Factor: φ_c

Structural Condition of Member	φ_c
Good or Satisfactory	1.00
Fair	0.95
Poor	0.85

Table C6A.4.2.3-1—Approximate Conversion in Selecting φ_c

Superstructure Condition Rating (SI & A Item 59)	Equivalent Member Structural Condition
6 or higher	Good or Satisfactory
5	Fair
4 or lower	Poor

For the condition factor for this project, a value of 0.95 has been assumed per MnDOT direction. Considering Table C6A.4.2.3-1, it is likely that this factor could be increased to 1.00, given the condition of the structural steel on the bridge.

Table 6A.4.2.4-1—System Factor: φs for Flexural and Axial Effects

Superstructure Type	φ_s
Welded Members in Two-Girder/Truss/Arch Bridges	0.85
Riveted Members in Two-Girder/Truss/Arch Bridges	0.90
Multiple Eyebar Members in Truss Bridges	0.90
Three-Girder Bridges with Girder Spacing 6 ft	0.85
Four-Girder Bridges with Girder Spacing ≤4 ft	0.95
All Other Girder Bridges and Slab Bridges	1.00
Floorbeams with Spacing >12 ft and Noncontinuous Stringers	0.85
Redundant Stringer Subsystems between Floorbeams	1.00

For the system factor for this project, the following factors were assumed:

- Truss Stringers 1.00
- Truss Floorbeams 0.85
- Truss Riveted Truss Members 0.90
- Approach Girders 1.00

It should be noted, that using the values listed above for condition factor and system factors, the following are the combined reduction in strength of particular members used in the ratings (not including the LRFD resistance factors that must also be applied):

- Truss Stringers 0.95
- Truss Floorbeams 0.808, which is < 0.85, therefore use 0.85
- Truss Riveted Truss Members 0.855
- Approach Girders 1.00

A list of additional assumptions that were used for the development of these ratings includes:

- The LFR rating computations (specifically with respect to the calculation of member capacities) was in accordance with the 17th Edition AASHTO Standard Specifications for Highway Bridges with reference to the AASHTO Guide Specifications for Strength Design of Truss Bridges (Load Factor Design), where applicable, and the AASHTO

Manual for Bridge Evaluation, 2nd Edition, 2011.

- The LRFR rating computations (specifically with respect to the calculation of member capacities) was in accordance with the 5th Edition AASHTO LRFD Bridge Design Specifications, with reference to the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011.

- Inventory (IRF) and Operating (ORF) ratings (for vertical load effects only) are provided for each component for the design live load (either HS20 or HL93) and ORF are provided for permit vehicles.

- Truss members have been rated for axial loads only (neglecting shear and flexure considerations).

- Truss gusset plates have been rated using normal MnDOT assumptions, procedures and spreadsheet tools.

- Approach span girders have been rated for both flexure and shear.

2.6.3 Discussion of Difference Between LFR and LRFR Ratings

Given that the analyses run for several of the most likely rehabilitation scenarios (Analysis 10 and Analysis 12, as previously described) result in relatively poor LRFR ratings, it was decided that supplemental analyses (10A and 12A) would be made using HS20 live loads and computing resulting LFR rating factors for comparison.

Analysis 10A – A 2D analysis with a new conventional (normal weight) concrete deck and a new 6' wide cantilever sidewalk on each side of the bridge, using HS20 live load and LFR.

Analysis 12A – A 2D analysis with a new lightweight deck (i.e. exodermic) and a new 6' wide cantilever sidewalk on each side of the bridge, using HS20 live load and LFR.

As shown in the truss member rating table for Analysis 10A, in Section 4, for the design load HS20-44, the bridge members have inventory rating factors above 0.9 and operating rating factors above 1.15 when the LFR provisions are used as rating criteria. According to MnDOT, the limits IRF $\geq$ 0.9 and ORF $\geq$ 1.15 are minimum requirements for the bridge ratings. Hence, the bridge truss spans satisfy rating requirements for the design load if the LFR provisions are used for the calculations. In Analysis 10, when the truss is studied using the LRFR specifications, 50 members do not meet the above requirements for the HL93 inventory rating factors. The controlling rating factor is 0.17 that corresponds to bottom chord member L8-L9. The same member in the LFR ratings has an IRF of 1.58. The reasons for this difference are explained by studying the factors involved in the rating calculations.

For LFR the L8-L9 member capacities, DC and LL forces are:

$DC = 602.2\,\text{kips}$
$C_y = A_g \cdot F_y = 1236.0\,\text{kips}$ (yielding in the gross section)
$C_u = A_n \cdot F_u = 1249.0\,\text{kips}$ (fracture in the net seccion)
$LL = 121.0\,\text{kips}$ (HS20 - 44 Lane Load)
$IM = 0.09$

Hence, the inventory rating factor is:

$$IRF = \frac{C - 1.3DC}{2.17(1+IM)LL} = \frac{1236.0 - 1.3 \cdot 602.2}{2.17 \cdot 1.09 \cdot 121.0} = \frac{1236.0 - 782.9}{286.2} = 1.58$$

For LRFR the member capacities, DC and LL forces are:

$DC = 602.2\,\text{kips}$
$C_y = \phi_y \cdot A_g \cdot F_y = 1174.2\,\text{kips}$ (yielding in the gross section)
$C_u = \phi_u \cdot A_n \cdot F_u \cdot R_p \cdot U = 949.9\,\text{kips}$ (fracture in the net seccion)
$LL_T = 76.2\,\text{kips}$ (HL93 Truck Load)
$LL_L = 101.3\,\text{kips}$ (HL93 Lane Load)
$IM = 0.33$

Hence, the inventory rating factor is:

$$IRF = \frac{\phi_c \cdot \phi_s \cdot C - \gamma_{DC} DC}{\gamma_{LL}(1+IM)LL} = \frac{0.95 \cdot 0.9 \cdot 949.9 - 1.25 \cdot 602.2}{1.75(76.2 \cdot 1.33 + 101.3)} = \frac{812.2 - 752.8}{354.6} = 0.17$$

Comparing LRFR vs. LFR results it is observed that the ratio of the member capacities (LRFR/LFR) is 812.2 / 1236.0 = 0.66, the dead load ratio is 752.8 / 782.9 = 0.96, and the live load ratio is 354.6 / 286.2 = 1.24. Therefore, when using LRFR provisions, there is a reduction of 34% in member capacity and an increase of 24% in the factored live load, with respect to the LFR results. In the case of the dead load, there is a minor decrease of 4%.

The considerable reduction in the member capacity and the increase in the live load force result in the drop of the IRF from 1.58 to 0.17. This example shows the differences between rating methods and the consequences of using either of them.

Section 3 Relevant Design/Evaluation Criteria

3.1 Draft Bridge Criteria

The proposed project Bridge Criteria was originally submitted to MnDOT in draft form on April 6, 2012. This contents of this initial version was discussed at the April 27, 2012 meeting between the project team and MnDOT personnel at the MnDOT office in Oakdale. Based on those discussions and additional input throughout the progression of the project, the Bridge Criteria has been updated, and a current version has been included in Appendix B of this report. This document will continue to be updated as the project progresses, and is still considered to be in draft form.

Some of the more pertinent criteria for the rehabilitation alternatives for the bridge have been highlighted in the section which follows.

3.2 Highlighted Criteria

3.2.1 Dead Loads

- Existing Truss Assumed Detail Percentage – 28% of Main Truss Members (chords, diagonals, braces). This value was selected based on a correlation of bridge dead loads from the current analyses and the original design drawings. It should be noted that at the time this value was selected, it was unclear if a Future Wearing Course load had been included in the original design of the truss. Based on information provided by MnDOT, it appears that a FWC allowance was included in the design of the approach unit, however no indication was found for the truss spans. Conservatively, the 28% assumption has been maintained.

- Bridge railing (Existing Bridge No. 9040) = 200 plf (Each)

- Bridge railing (For Redecking/Rehabilitation) = 350 plf (Each) Concrete Parapet Type P-1 TL-2

- Future Wearing Course (DW) for future conditions = 20 psf

3.2.2 Live Loads

- LFD Ratings for Existing Condition - HS20

- LRFR Ratings for Rehabilitated Condition - HL93

- Permit loads to be considered for this project:

    - Standard A Truck: GVM = 104 kips, and Length = 46’-0”

    - Standard B Truck: GVM = 136 kips, and Length = 49’-0”

- Standard C Truck: GVM = 159 kips, and Length = 57'-0"
- P411 Truck: GVM = 207 kips, and Length = 93'-0"
- P413 Truck: GVM = 255 kips, and Length = 117'-0"

3.2.3 Material Properties – Existing Bridge

Structural Steel

Plan Designation- Structural Steel - MHD 3305: Fy = 33 ksi, Fu = 60 ksi

Plan Designation – Intermediate Strength Manganese Copper Bearing Structural Steel: Fy = 42 ksi, Fu = 65 ksi

Plan Designation - Phosphorous Chromium Steel - MHD 3309: Fy = 47 ksi, Fu = 67 ksi

Plan Designation - Girder Hanger Pins - MHD 3313

Girder Hanger Plates Phosphorous Chromium Steel - MHD 3309: Fy = 47 ksi, Fu = 67 ksi

Plan Designation - Truss Hanger Pins MHD 3315

Truss Hanger Plates - Q-T Low Alloy Struct. Steel (Type I) MHD 3318: Fy = 90 ksi, Fu = 105 ksi
(Based on specification information available)

Concrete

Concrete: f'c = 3,000 psi

Reinforcing Steel

Reinforcing Steel: Fy = 36 ksi, fs = 20 ksi

3.2.4 Material Properties – New Construction

Structural Steel

ASTM A709 (AASHTO M270) Grade 50W Fy = 50 ksi and Grade HPS 70W Fy = 70 ksi

Concrete

Superstructure Deck: f'c = 4,000 psi

Substructure – Abutments and Piers: f'c = 4,000 psi

Substructure – Footing: f'c = 4,000 psi

Reinforcing Steel

Reinforcing Steel: Fy = 60 ksi

Epoxy Reinforcing Steel: Fy = 60 ksi

3.3 Additional Points from April 27, 2012 Meeting

The following additional notes are taken from the meeting minutes from the April 27, 2012 meeting. *Later modifications or actions taken are shown in italics*:

Truss Modeling Methodology and Assumptions

- HDR assumed 490 pcf plus 20% for details for steel weight. It was decided that 20% should be used going forward, but HDR is also to verify that assumption compares well to the original plan steel weights. *This value was later adjusted to 28% based on original plan steel weights – see discussion in Section 3.2.1.*
- HDR recommended and MnDOT concurred that the 3D effects should not be considered when evaluating the main truss members, except on a case by case basis if a member is only slightly over capacity. *Main truss members have been evaluated based on the 2D analyses.*
- WSB evaluation concluded that the gusset plates rate higher than, or similar to the truss main members.

Scope of Rehab

- The inspection work in April of 2012 did not uncover any concerns. Bridge 9040 is in good condition for its age. As directed, HDR will use a Condition Factor of 0.95 for Bridge 9040 given its condition (no appreciable section loss noted in previous inspections). *Condition factor of 0.95 has been used for these analyses.*
- HDR will send inspection photos along with general findings to the Bridge Office to confirm the use of the 0.95 Condition Factor. This assumption will also be confirmed during the fracture critical inspection to occur in June. *Verification has been completed and was confirmed during the June fracture critical inspection.*
- Need to address deck shrinkage when assessing joint elimination in the truss spans. Also the impact of joint elimination on the floorbeams (i.e. due to increased lateral loads due to deck continuity) needs to be included in that assessment. *The impact of eliminating deck joints on the floorbeams was assessed based on the results of Analysis 8.*
- Redecking needs to assume maintaining one lane of traffic. However, can assume that some short term closures may be needed. Even during short full closures an emergency plan will need to be in place due to the emergency services coverage across the river. A qualitative assessment of what is possible for staging should be included in the rehab study. *A staging analysis with half-width deck replacement has been made (Analysis 9) and the results are included in this report. While feasible, staged deck replacement would*

necessitate the strengthening of additional truss members (particularly diagonal members).

- If the approach spans can be maintained with deck replacement only, then the cost of hanger elimination needs to be included in the repair plans. Also, an assessment of what the elimination of the hangers does to the bearings and joints will be completed. *For any approach span rehabilitation, elimination of the hangers has been included. It is assumed that new joints will be provided with the new deck. It is also assumed that all of the existing bearings will need to be modified or replaced.*
- Need to assess whether a cantilevered sidewalk can be feasibly connected to the truss. Special considerations will be required at the joint with the pin and hanger. *It has been determined that a cantilever walkway is feasible. A preliminary design has been completed, and conceptual details are provided in Appendix C.*
- Fatigue assessment of the coverplates on the approach span girders and also the truss floorbeams is needed. *It is recommended that all coverplate locations on the truss floorbeams and approach girders (in tension or reversal zones) be retrofitted with bolted splices to mitigate fatigue concerns.*

Options for Lowering the Weight of the Deck

- Consider all lighter weight deck options for cantilevered sidewalk. *For the preliminary design of the cantilever sidewalk (and its load contribution to the truss), a lightweight exodermic deck option (shallow WT4x5 with main bars at 12" spacing) was utilized. This results in a sidewalk deck weight of approximately 60 psf.*
- Will not consider light weight concrete for roadway deck, just the cantilevered sidewalk. *Will not be considered as an option for the roadway slab per MnDOT direction.*
- Will not consider the overfilled steel grid with an overlay for roadway deck, just the cantilevered sidewalk. *Will not be considered as an option per MnDOT direction.*
- Will run the truss model with lighter deck type assumptions (i.e. by assuming a deck which weighs approximately 70 PSF) to assess whether they produce enough dead load reduction to accommodate a cantilevered sidewalk. *For the lightweight deck analyses, the deck weight of 70 PSF was utilized. It was confirmed that grid or exodermic decks of this weight would be appropriate for this project.*
- Need to determine whether water needs to be collected for the roadway deck and/or the sidewalk. *To be determined - not assessed in this report.*
- Assuming adding girders for sidewalk on approach spans. *This is the approach which was taken for these studies.*
- Are also assessing cross-section options within the existing truss to accommodate improved ped/bike accommodations. HDR will layout a matrix of alternatives. *Possible cross-section options within the existing truss were submitted to MnDOT, and comments were received. A copy of the drawing showing the options is provided in Appendix D. Based on the MnDOT review, raised sidewalks were not desirable. Cantilever sidewalks*

would be preferred. If cantilever sidewalks cannot be provided, the widest shoulders possible would be the next most desirable option.

Loading Scenarios

- 2D analysis will conservatively be used for the primary evaluation of the truss main members and gusset plates. The 3D analyses will be used to provide information on the possible benefit to the main members of considering 3D load distribution and the possible negative impacts on secondary members and floor system. *This is the approach that was used.*
- Will use HS20 live load to assess existing conditions. Actual (current) 8 ½" deck thickness will be used along with appropriate steel detail weight. Will use HL93 and LRFR to check any repair, strengthening or replacement options. *This is the approach that was used.*
- Use 8.5 inch deck thickness for conventional concrete deck replacement. Assume stainless steel rebar and do not include additional dead load for future wearing surface. *This is the approach that was used.*
- Will first study adding 6-foot walk to each side of the truss and only look at a 10-foot walk on one side if the 6-foot walk works. *6-foot cantilever walks on both sides were investigated and results included in this report. Analyses for a 10-foot wide sidewalk on one side were not run at this time, due to the fact that there were numerous member retrofits necessary for the 6' cantilever sidewalks, and the local and global effects of the 10' sidewalk would be significantly worse.*
- Need to run model for 3-lane option and determine rating feasibility. *This analysis was run (Analysis 6) and the results included in this report.*
- As part of these evaluations of the Rehabilitation Alternatives, wind loads will not be considered. *Wind loads were not included in these studies per MnDOT direction.*
- HDR will produce a matrix that presents all of the scenarios and have MnDOT review before proceeding with more analysis. *The project team developed a matrix of various analyses that might need to be performed. This table of analyses was submitted to MnDOT on May 29, 2012, and is provided in Appendix A.*

Design Criteria Document

- Vessel collision: Winona incorporated results from Hastings where a detailed study was conducted. The resulting Winona load was 3100 kips. Red Wing should use Hastings and Dresbach findings. Todd Stevens will provide Dresbach and Hastings results. *The loads and conditions defined for the Hastings Project were utilized for the vessel collision evaluation for this project.*

- Ice loads may need to be adjusted from the LRFD Manual since this is a major river. HDR should compare to the St. Croix loading in the preliminary plan. *Ice loads not included in this rehabilitation report since the focus is the superstructure.*
- If the inventory rating factor is less than 0.9 for the design vehicle or the operating rating factor is less than 1.15 for permit vehicles the member needs to be strengthened or replaced. The repair plan needs to bring the inventory rating to a minimum of 1.0. *This is the approach that was used for these studies.*
- A barrier with a lower dead load should be used for the rehab alternatives (around 250 pounds per lineal foot). *This is the approach that was used for these studies.*
- Add an alternative for a new four-lane river span to be built all at once. *Has been incorporated.*
- Need to add fatigue design criteria to the document. *The Design Criteria document will be updated with relevant fatigue criteria as the project moves into later design stages.*
- Need to review the load factors used for Strength IV load case. MnDOT to provide direction on any deviations from AASHTO. *MnDOT to provide direction for future work.*
- In Section 1.3.2 of the document, Replacement Alternatives that do not provide a 12' trail can be removed from consideration. Also on Replacement Alternatives, the trail width will be revised from 10' to 12'. *These changes have been incorporated.*

Other

- Waiting on official feedback from Coast Guard. Should assume new structure cannot reduce horizontal clearance. May be able to reduce vertical from 64 feet to 62 feet which is the clearance up and downstream. MnDOT will verify the vertical clearances being provided at Winona and Dresbach. *Based on MnDOT's initial correspondence with the USCG, a new companion bridge located immediately upstream of the existing bridge would satisfy the reasonable needs of navigation. The navigational opening of the new companion bridge must match the existing bridge.*

Section 4 Load Rating Results

4.1 Main Truss Unit (Spans 1 through 3) Results

This section contains tabular rating results for the main truss components evaluated for these studies. As previously discussed, results are generally presented for Analyses 2, 3, 4, 5, 6, 9, 10, 10A, 12, and 12A, unless noted.

4.1.1 Floor System Results

The tables on pages 37 and 38 provide inventory and operating rating results for the floor system members (stringers, end floorbeams and intermediate floorbeams) for the various live load cases. The rating methodologies used are as previously described. 3D Analyses 3 and 9 are not included in the summaries.

4.1.2 Main Truss Member Results

The tables on pages 39 through 48 provide inventory and operating rating results for the main truss members for the various live load cases. The rating methodologies used are as previously described.

4.1.3 Main Truss Gusset Results

The tables on pages 49 through 61 provide inventory and operating rating results for the main truss gusset plates for the various live load cases. The rating methodologies used are as previously described.

4.2 Approach Span (Spans 4 through 9) Results

This section also contains tabular rating results for the approach spans as evaluated for these studies. As previously discussed, all results presented are for scenarios that include elimination of the pin-and-hanger joints. The summaries provided on pages 62 through 73 show minimum rating factors at the points of interest, either flexure or shear, whichever controls.

Floor System Results – Sheet 1 of 2

	ANALYSIS 2						
	HS20		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.07	1.78	1.88	1.59	1.53	1.53	1.60
Intermediate Floorbeam	1.06	1.76	1.58	1.45	1.41	1.39	1.41
Stringer	1.16	1.94	1.92	1.46	1.35	1.47	1.47
Minimum Floorsystem	1.06	1.76	1.58	1.45	1.35	1.39	1.41
WSB Rating Factors from Recent Analysis >	**1.08**	**1.83**	**1.85**	**1.39**	**1.28**	**1.45**	**1.40**

NOTE - For Analysis 2 only, minimum floorsystem rating factor controls over truss rating factor

	ANALYSIS 4						
	HL93		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.77	2.29	2.09	1.95	1.90	1.89	1.96
Intermediate Floorbeam	1.88	2.43	2.07	1.94	1.91	1.98	1.88
Stringer	2.25	2.91	2.57	2.57	2.40	2.57	2.57
Minimum Floorsystem	1.77	2.29	2.07	1.94	1.90	1.89	1.88

	ANALYSIS 5						
	HL93		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.58	2.05	1.93	1.82	1.78	1.77	1.83
Intermediate Floorbeam	1.74	2.26	2.00	1.89	1.86	1.84	1.86
Stringer	1.80	2.34	1.92	1.92	1.92	1.92	1.92
Minimum Floorsystem	1.58	2.05	1.92	1.82	1.78	1.77	1.83

	ANALYSIS 6						
	HL93		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.22	1.58	1.38	1.27	1.24	1.24	1.27
Intermediate Floorbeam	1.36	1.76	1.41	1.34	1.32	1.31	1.31
Stringer	1.78	2.30	1.94	1.94	1.94	1.94	1.94
Minimum Floorsystem	1.22	1.58	1.38	1.27	1.24	1.24	1.27

	Design Load		Permit
	Inventory	Operating	Load
	γ_{DC}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

Floorbeams		
ϕ_C	ϕ_S	max (ϕ_C·ϕ_S, 0.85)
0.95	0.85	0.85

Stringers		
ϕ_C	ϕ_S	max (ϕ_C·ϕ_S, 0.85)
0.95	1.00	0.95

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Floor System Results – Sheet 2 of 2

	ANALYSIS 10						
	HL93		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.79	2.32	2.18	2.06	2.01	2.01	2.07
Intermediate Floorbeam	1.93	2.50	2.21	2.09	2.06	2.04	2.05
Stringer	2.22	2.88	2.59	2.59	2.52	2.59	2.59
Minimum Floorsystem	1.79	2.32	2.18	2.06	2.01	2.01	2.05

	ANALYSIS 10a						
	HS20		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	2.03	3.38	3.93	3.71	3.62	3.61	3.72
Intermediate Floorbeam	1.95	3.26	4.14	3.92	3.85	3.81	3.83
Stringer	2.48	4.14	4.52	4.52	4.39	4.52	4.52
Minimum Floorsystem	1.95	3.26	3.93	3.71	3.62	3.61	3.72

	ANALYSIS 12						
	A12-BAR7 HL93		A12-BAR7 STD. A	A12-BAR7 STD. B	A12-BAR7 STD. C	A12-BAR7 P411	A12-BAR7 P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.61	2.09	1.96	1.85	1.81	1.80	1.86
Intermediate Floorbeam	1.79	2.32	2.06	1.95	1.92	1.90	1.91
Stringer	1.78	2.30	1.94	1.94	1.94	1.94	1.94
Minimum Floorsystem	1.61	2.09	1.94	1.85	1.81	1.80	1.86

	ANALYSIS 12a						
	HS20		STD. A	STD. B	STD. C	P411	P413
	IRF	ORF	RF	RF	RF	RF	RF
Exterior Floorbeam	1.70	2.83	3.50	3.30	3.22	3.22	3.31
Intermediate Floorbeam	1.74	2.90	3.79	3.59	3.53	3.49	3.51
Stringer	2.27	3.79	3.38	3.38	3.38	3.38	3.38
Minimum Floorsystem	1.70	2.83	3.38	3.30	3.22	3.22	3.31

		Design Load		Permit
		Inventory	Operating	Load
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

Floorbeams		
ϕ_C	ϕ_S	max (ϕ_C·ϕ_S, 0.85)
0.95	0.85	0.85

Stringers		
ϕ_C	ϕ_S	max (ϕ_C·ϕ_S, 0.85)
0.95	1.00	0.95

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Truss Member Results – Analysis 2

					HS20-44			STD. A		STD. B		STD. C		P411		P413	
	Member	DL	Capacity	Impact	LL	IRF	ORF	LL	ORF	LL	ORF	LL	ORF	LL	ORF	LL	ORF
Lower Chord	L0-L1	96.5	674.8	1.15	82.3	2.67	4.46	85.8	4.27	101.1	3.63	111.6	3.29	124.6	2.94	137.5	2.67
	L1-L2	96.5	674.8	1.15	82.3	2.67	4.46	85.8	4.27	101.1	3.63	111.6	3.29	124.6	2.94	137.5	2.67
	L2-L3	-101.9	709.9	1.11	-151.6	1.58	2.64	-126.2	3.17	-146.3	2.73	-160.3	2.49	-183.4	2.18	-205.9	1.94
	L3-L4	-101.9	709.9	1.11	-151.6	1.58	2.64	-126.2	3.17	-146.3	2.73	-160.3	2.49	-183.4	2.18	-205.9	1.94
	L4-L5	-609.6	1518.8	1.11	-184.7	1.63	2.72	-153.6	3.27	-178.1	2.82	-195.1	2.58	-223.3	2.25	-250.8	2.00
	L5-L6	-609.6	1518.8	1.11	-184.7	1.63	2.72	-153.6	3.27	-178.1	2.82	-195.1	2.58	-223.3	2.25	-250.8	2.00
	L6-L7	-462.2	1106.1	1.11	-101.3	2.07	3.45	-88.4	3.96	-103.1	3.39	-113.0	3.09	-129.0	2.71	-145.2	2.41
	L7-L8	-462.2	1106.1	1.11	-101.3	2.07	3.45	-88.4	3.96	-103.1	3.39	-113.0	3.09	-129.0	2.71	-145.2	2.41
	L8-L9	487.3	1236.0	1.09	109.6	2.32	3.87	100.8	4.21	118.0	3.60	129.7	3.27	147.6	2.88	165.4	2.57
	L9-L10	487.3	1236.0	1.09	109.6	2.32	3.87	100.8	4.21	118.0	3.60	129.7	3.27	147.6	2.88	165.4	2.57
	L10-L11	1046.7	2750.5	1.09	234.9	2.50	4.17	214.5	4.57	251.1	3.90	275.8	3.55	309.5	3.16	347.2	2.82
	L11-L12	1046.7	2750.5	1.09	234.9	2.50	4.17	214.5	4.57	251.1	3.90	275.8	3.55	309.5	3.16	347.2	2.82
Upper Chord	U1-U2	-62.7	709.9	1.15	-131.7	1.91	3.19	-136.5	3.07	-161.2	2.60	-177.2	2.37	-194.8	2.15	-214.4	1.96
	U2-U3	-62.7	709.9	1.15	-131.7	1.91	3.19	-136.5	3.07	-161.2	2.60	-177.2	2.37	-194.8	2.15	-214.4	1.96
	U3-U4	344.4	1236.0	1.11	174.0	1.88	3.13	144.8	3.77	167.8	3.25	183.8	2.97	210.4	2.59	236.2	2.31
	U4-U5	344.4	1236.0	1.11	174.0	1.88	3.13	144.8	3.77	167.8	3.25	183.8	2.97	210.4	2.59	236.2	2.31
	U5-U6	1036.3	2524.6	1.11	221.6	2.21	3.68	184.4	4.42	213.8	3.81	234.1	3.48	268.0	3.04	301.0	2.71
	U6-U7	1036.3	2524.6	1.11	221.6	2.21	3.68	184.4	4.42	213.8	3.81	234.1	3.48	268.0	3.04	301.0	2.71
	U7-U8	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U9-U10	-836.1	1922.7	1.09	-187.9	1.88	3.13	-172.3	3.42	-201.6	2.92	-221.6	2.66	-251.0	2.35	-279.7	2.11
	U10-U11	-836.1	1922.7	1.09	-187.9	1.88	3.13	-172.3	3.42	-201.6	2.92	-221.6	2.66	-251.0	2.35	-279.7	2.11
	U11-U12	-1114.1	2533.1	1.09	-250.5	1.83	3.05	-227.8	3.36	-266.0	2.87	-291.7	2.62	-325.7	2.35	-365.4	2.09
Verticals	L1-U1	122.8	708.2	1.25	68.0	2.97	4.96	74.3	4.54	82.9	4.07	85.5	3.94	87.3	3.86	86.3	3.90
	L2-U2	-9.2	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L3-U3	124.2	1278.0	1.25	68.0	6.05	10.09	74.3	9.23	82.9	8.28	85.5	8.02	87.3	7.86	86.3	7.95
	L4-U4	-9.6	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L5-U5	129.5	708.2	1.25	68.0	2.93	4.88	74.3	4.46	82.9	4.00	85.5	3.88	87.3	3.80	86.3	3.84
	L6-U6	-16.1	314.2	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L7-U7	127.2	708.2	1.25	68.0	2.94	4.90	74.3	4.49	82.9	4.02	85.5	3.90	87.3	3.82	86.3	3.86
	L8-U8	-8.0	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L9-U9	124.2	708.2	1.25	68.0	2.96	4.94	74.3	4.52	82.9	4.05	85.5	3.93	87.3	3.85	86.3	3.89
	L10-U10	-13.5	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L11-U11	128.7	1278.0	1.25	68.0	6.02	10.04	74.3	9.18	82.9	8.23	85.5	7.98	87.3	7.82	86.3	7.91
	L12-U12	-9.7	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-140.3	910.1	1.15	-130.7	2.23	3.72	-128.9	3.77	-151.2	3.21	-166.3	2.92	-185.2	2.62	-204.0	2.38
	U1-L2	-49.2	579.0	1.30	-81.5	2.24	3.73	-64.0	4.75	-73.8	4.12	-80.5	3.78	-91.7	3.32	-102.5	2.97
	L2-U3	239.3	708.2	1.24	92.8	1.59	2.65	68.2	3.61	77.9	3.16	84.7	2.90	95.8	2.57	106.7	2.31
	U3-L4	-343.4	814.1	1.19	-100.1	1.42	2.37	-96.2	2.47	-111.3	2.13	-120.8	1.96	-125.6	1.89	-128.8	1.84
	L4-U5	477.1	1278.0	1.17	126.3	2.05	3.42	119.4	3.62	138.9	3.11	151.7	2.85	164.9	2.62	177.1	2.44
	U5-L6	-749.5	1731.0	1.15	-171.6	1.77	2.95	-134.8	3.75	-154.4	3.27	-167.7	3.01	-184.4	2.74	-201.0	2.51
	L6-U7	-1008.5	2394.7	1.10	-223.6	2.03	3.38	-178.7	4.23	-207.5	3.65	-227.2	3.33	-259.6	2.91	-293.2	2.58
	U7-L8	812.1	2061.8	1.11	189.5	2.20	3.67	159.8	4.36	185.5	3.75	203.0	3.43	231.2	3.01	259.5	2.68
	L8-U9	-708.6	1959.5	1.12	-171.2	2.50	4.16	-151.1	4.71	-176.0	4.05	-193.0	3.69	-219.1	3.25	-245.1	2.91
	U9-L10	507.1	1278.0	1.13	130.7	1.93	3.22	122.7	3.43	143.6	2.93	157.7	2.67	177.7	2.37	197.4	2.13
	L10-U11	-306.3	784.5	1.15	-95.0	1.63	2.72	-95.7	2.70	-112.4	2.30	-123.4	2.09	-137.0	1.88	-150.6	1.71
	U11-L12	98.0	708.2	1.17	65.2	3.51	5.85	71.1	5.36	83.7	4.56	91.8	4.15	99.2	3.84	106.6	3.58
					U3-L4	**1.42**	**2.37**	**U3-L4**	**2.47**	**U3-L4**	**2.13**	**U3-L4**	**1.96**	**L10-U11**	**1.88**	**L10-U11**	**1.71**
	WSB Rating Factors from Recent Analysis >					**1.48**	**2.50**		**2.54**		**2.19**		**2.02**		**1.9**		**1.72**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Truss Member Results – Analysis 3

		A3 - LARSA 3D						WSB STAAD MODEL					
					HS20-44						HS20-44		
	Member	DL	Capacity	Impact	LL	IRF	ORF	DL	Capacity	Impact	LL	IRF	ORF
Lower Chord	L0-L1	81.5	674.8	1.15	62.5	3.65	6.08	76.7	639.1	1.147	75.5	2.82	4.74
	L1-L2	75.1	674.8	1.15	57.1	4.05	6.75	76.5	639.1	1.147	66.9	3.18	5.35
	L2-L3	-80.2	709.9	1.11	-116.7	2.15	3.59	-126.3	652.3	1.147	-125.2	1.56	2.60
	L3-L4	-74.8	709.9	1.11	-102.2	2.49	4.15	-127.1	652.3	1.147	-122.8	1.58	2.65
	L4-L5	-558.2	1518.8	1.11	-152.0	2.17	3.61	-602.9	1440.0	1.147	-156.9	1.61	2.74
	L5-L6	-520.0	1518.8	1.11	-139.7	2.50	4.17	-592.2	1440.0	1.147	-152.2	1.70	2.88
	L6-L7	-396.3	1106.1	1.11	-90.2	2.72	4.53	-468.7	1056.9	1.09	-101.4	1.77	3.02
	L7-L8	-379.4	1106.1	1.11	-86.8	2.93	4.88	-460.8	1088.3	1.09	-100.3	1.96	3.34
	L8-L9	374.7	1236.0	1.09	85.4	3.71	6.18	398.3	1048.6	1.09	94.9	2.27	3.85
	L9-L10	365.9	1236.0	1.09	79.9	4.02	6.70	416.8	1048.6	1.09	97.3	2.10	3.57
	L10-L11	995.2	2750.5	1.09	214.1	2.88	4.79	939.4	2353.0	1.09	216.8	2.11	3.58
	L11-L12	997.6	2750.5	1.09	211.7	2.90	4.84	939.8	2353.0	1.09	215.8	2.11	3.60
Upper Chord	U1-U2	-52.9	709.9	1.15	-117.4	2.19	3.65	-32.0	652.3	1.147	-119.5	2.02	3.39
	U2-U3	-50.9	709.9	1.15	-117.7	2.19	3.65	-29.5	652.3	1.147	-120.1	2.02	3.40
	U3-U4	313.3	1236.0	1.11	155.3	2.22	3.69	334.6	1048.6	1.147	153.9	1.58	2.65
	U4-U5	314.9	1236.0	1.11	158.0	2.17	3.62	336.5	1048.6	1.147	155.9	1.55	2.60
	U5-U6	1011.3	2524.6	1.11	221.7	2.27	3.78	1013.5	2352.8	1.147	215.2	1.84	3.13
	U6-U7	1011.3	2524.6	1.11	221.8	2.26	3.77	1013.5	2352.8	1.09	215.3	1.93	3.29
	U7-U8	0.0	435.4	1.11	-0.1			0.1	639.1	1.09	2.2		
	U8-U9	-0.3	435.4	1.11	0.0			-0.7	424.2	1.09	0.0		
	U9-U10	-788.2	1922.7	1.09	-176.9	2.15	3.58	-766.7	1731.3	1.09	-180.0	1.63	2.78
	U10-U11	-790.4	1922.7	1.09	-174.0	2.18	3.63	-769.7	1731.3	1.09	-178.8	1.63	2.78
	U11-U12	-1065.7	2533.1	1.09	-231.8	2.09	3.49	-1034.0	2305.1	1.09	-238.3	1.60	2.74
Verticals	L1-U1	132.8	708.2	1.25	59.4	3.32	5.54	111.1	639.1	1.147	63.9	3.05	5.14
	L2-U2	-8.7	435.3	1.25	-0.4			-11.4	413.3	1.147	-0.1		
	L3-U3	153.1	1278.0	1.25	59.3	6.71	11.19	108.3	886.5	1.147	60.0	4.93	8.27
	L4-U4	-8.8	368.3	1.25	-0.2			-11.9	349.6	1.147	-0.1		
	L5-U5	159.9	708.2	1.25	60.6	3.04	5.07	102.3	639.1	1.147	59.4	3.36	5.65
	L6-U6	-21.8	314.2	1.25	-1.1			-29.5	235.4	1.147	-1.1		
	L7-U7	148.5	708.2	1.25	61.0	3.11	5.19	106.7	639.1	1.09	61.3	3.40	5.71
	L8-U8	-583.6	368.3	1.25	-143.0			-6.4	349.6	1.09	-3.3		
	L9-U9	150.9	708.2	1.25	61.1	3.09	5.15	121.2	639.1	1.09	62.4	3.21	5.39
	L10-U10	-10.7	435.3	1.25	-0.1			-9.4	413.3	1.09	-0.1		
	L11-U11	138.9	1278.0	1.25	58.8	6.89	11.48	111.2	886.5	1.09	60.0	5.18	8.67
	L12-U12	-14.8	435.3	1.25	-0.3			-14.6	413.3	1.09	-0.1		
Diagonals	L0-U1	-145.6	910.1	1.15	-128.0	2.26	3.76	-120.1	883.3	1.147	-117.4	2.44	4.10
	U1-L2	-61.2	579.0	1.30	-76.3	2.32	3.87	-63.2	575.3	1.147	-72.4	2.73	4.56
	L2-U3	211.1	708.2	1.24	86.7	1.86	3.10	243.3	639.1	1.147	84.7	1.48	2.50
	U3-L4	-358.1	814.1	1.19	-102.2	1.32	2.20	-330.4	793.1	1.147	-89.8	1.54	2.63
	L4-U5	441.6	1278.0	1.17	119.9	2.31	3.85	453.1	1084.2	1.147	114.9	1.63	2.79
	U5-L6	-754.1	1731.0	1.15	-175.8	1.71	2.85	-712.3	1713.7	1.147	-156.1	1.92	3.28
	L6-U7	-1006.8	2394.7	1.10	-228.1	1.99	3.32	-987.4	2334.6	1.09	-208.7	2.03	3.45
	U7-L8	779.4	2061.8	1.11	187.7	2.32	3.86	796.4	1860.8	1.09	173.9	1.91	3.25
	L8-U9	-718.3	1959.5	1.12	-175.3	2.41	4.01	-688.3	2080.5	1.09	-161.4	3.01	5.09
	U9-L10	472.2	1278.0	1.13	122.2	2.22	3.70	468.8	1084.2	1.09	118.2	1.60	2.74
	L10-U11	-313.4	784.5	1.15	-95.3	1.59	2.64	-285.1	797.3	1.09	-85.2	2.04	3.46
	U11-L12	87.8	708.2	1.17	61.5	3.80	6.34	94.4	639.1	1.09	56.9	3.80	6.36
					U3-L4	**1.32**	**2.20**				**L2-U3**	**1.48**	**2.50**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Truss Member Results – Analysis 4

					HL-93						STD. A		STD. B		STD. C		P411		P413	
					LOAD		STRENGTH I		SERVICE II		ST. II		ST. II		ST. II		ST. II		ST. II	
	Member	DL	Capacity	Impact	Truck	Lane	IRF	ORF	IRF	ORF	LL	RF	LL	RF	LL	RF	LL	RF	LL	RF
Lower Chord	L0-L1	95.3	548.1	1.33	71.4	72.3	1.46	1.90	2.08	2.71	87.3	2.31	104.0	1.94	115.3	1.75	129.4	1.56	143.5	1.40
	L1-L2	95.3	548.1	1.33	71.4	72.3	1.46	1.90	2.08	2.71	87.3	2.31	104.0	1.94	115.3	1.75	129.4	1.56	143.5	1.40
	L2-L3	-101.5	552.6	1.33	-87.5	-144.7	0.93	1.21	1.33	1.73	-108.8	1.84	-130.6	1.53	-145.7	1.37	-170.7	1.17	-195.1	1.03
	L3-L4	-101.5	552.6	1.33	-87.5	-144.7	0.93	1.21	1.33	1.73	-108.8	1.84	-130.6	1.53	-145.7	1.37	-170.7	1.17	-195.1	1.03
	L4-L5	-604.2	1216.9	1.33	-106.5	-176.2	0.83	1.08	1.48	1.93	-132.6	1.64	-159.1	1.36	-177.5	1.22	-208.0	1.04	-237.7	0.91
	L5-L6	-604.2	1216.9	1.33	-106.5	-176.2	0.83	1.08	1.48	1.93	-132.6	1.64	-159.1	1.36	-177.5	1.22	-208.0	1.04	-237.7	0.91
	L6-L7	-458.0	883.3	1.33	-63.9	-95.2	0.99	1.28	1.82	2.36	-79.3	1.84	-95.2	1.53	-105.9	1.38	-123.3	1.18	-140.8	1.04
	L7-L8	-458.0	883.3	1.33	-63.9	-95.2	0.99	1.28	1.82	2.36	-79.3	1.84	-95.2	1.53	-105.9	1.38	-123.3	1.18	-140.8	1.04
	L8-L9	482.8	812.1	1.33	76.2	101.3	0.59	0.76	1.25	1.63	94.3	1.04	112.8	0.87	125.5	0.78	144.9	0.68	164.2	0.60
	L9-L10	482.8	854.3	1.33	76.2	101.3	0.71	0.92	1.41	1.83	94.3	1.25	112.8	1.05	125.5	0.94	144.9	0.81	164.2	0.72
	L10-L11	1037.3	2024.1	1.33	161.3	217.0	0.96	1.25	1.76	2.29	199.4	1.71	239.1	1.43	265.8	1.29	302.4	1.13	343.1	1.00
	L11-L12	1037.3	2024.1	1.33	161.3	217.0	0.96	1.25	1.76	2.29	199.4	1.71	239.1	1.43	265.8	1.29	302.4	1.13	343.1	1.00
Upper Chord	U1-U2	-61.6	552.6	1.33	-112.8	-115.7	1.02	1.33	1.42	1.85	-138.3	1.62	-165.1	1.35	-182.5	1.22	-201.6	1.11	-222.9	1.00
	U2-U3	-61.6	552.6	1.33	-112.8	-115.7	1.02	1.33	1.42	1.85	-138.3	1.62	-165.1	1.35	-182.5	1.22	-201.6	1.11	-222.9	1.00
	U3-U4	341.6	854.3	1.33	100.4	165.9	0.82	1.06	1.32	1.71	124.9	1.61	149.8	1.34	167.1	1.20	195.9	1.03	223.9	0.90
	U4-U5	341.6	854.3	1.33	100.4	165.9	0.82	1.06	1.32	1.71	124.9	1.61	149.8	1.34	167.1	1.20	195.9	1.03	223.9	0.90
	U5-U6	1026.7	2050.6	1.33	127.9	211.4	1.15	1.49	2.06	2.68	159.1	2.27	191.0	1.89	213.0	1.69	249.6	1.44	285.3	1.26
	U6-U7	1026.7	2050.6	1.33	127.9	211.4	1.15	1.49	2.06	2.68	159.1	2.27	191.0	1.89	213.0	1.69	249.6	1.44	285.3	1.26
	U7-U8	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U9-U10	-828.5	1634.8	1.33	-129.8	-173.6	0.99	1.28	1.79	2.33	-160.5	1.75	-192.3	1.46	-214.0	1.32	-245.9	1.15	-277.0	1.02
	U10-U11	-828.5	1634.8	1.33	-129.8	-173.6	0.99	1.28	1.79	2.33	-160.5	1.75	-192.3	1.46	-214.0	1.32	-245.9	1.15	-277.0	1.02
	U11-U12	-1104.4	2143.0	1.33	-171.1	-231.5	0.95	1.23	1.74	2.26	-211.4	1.70	-252.7	1.42	-280.7	1.28	-317.4	1.13	-361.0	0.99
Verticals	L1-U1	121.4	575.2	1.33	74.8	30.5	1.86	2.41	2.68	3.49	81.7	2.43	91.0	2.19	93.8	2.12	95.7	2.08	94.6	2.10
	L2-U2	-9.2	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L3-U3	122.8	838.9	1.33	74.8	30.5	3.01	3.90	4.24	5.51	81.7	3.94	91.0	3.54	93.8	3.43	95.7	3.36	94.6	3.40
	L4-U4	-9.6	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L5-U5	128.1	575.2	1.33	74.8	30.5	1.82	2.36	2.65	3.44	81.7	2.39	91.0	2.14	93.8	2.08	95.7	2.04	94.6	2.06
	L6-U6	-16.1	247.6	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L7-U7	125.8	575.2	1.33	74.8	30.5	1.84	2.38	2.66	3.46	81.7	2.40	91.0	2.16	93.8	2.09	95.7	2.05	94.6	2.08
	L8-U8	-8.0	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L9-U9	122.8	575.2	1.33	74.8	30.5	1.85	2.40	2.68	3.48	81.7	2.42	91.0	2.18	93.8	2.11	95.7	2.07	94.6	2.09
	L10-U10	-13.5	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L11-U11	127.3	847.1	1.33	74.8	30.5	3.02	3.92	4.26	5.54	81.7	3.95	91.0	3.55	93.8	3.44	95.7	3.38	94.6	3.42
	L12-U12	-9.7	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-138.5	731.9	1.33	-103.9	-105.2	1.31	1.70	1.88	2.44	-127.1	2.07	-151.2	1.74	-167.7	1.57	-188.2	1.40	-208.7	1.26
	U1-L2	-49.0	473.8	1.33	-42.4	-74.4	1.80	2.34	2.50	3.25	-52.8	3.67	-63.3	3.06	-70.6	2.75	-82.8	2.34	-94.6	2.05
	L2-U3	237.1	575.2	1.33	42.4	86.9	1.11	1.44	1.81	2.36	52.8	2.48	63.3	2.07	70.6	1.86	82.8	1.58	94.6	1.39
	U3-L4	-340.0	651.8	1.33	-78.7	-79.4	0.70	0.91	1.30	1.69	-94.1	1.13	-110.6	0.96	-120.8	0.88	-126.0	0.85	-129.5	0.82
	L4-U5	472.4	860.0	1.33	94.9	103.5	0.67	0.87	1.30	1.69	115.1	1.10	136.2	0.93	150.2	0.84	164.6	0.77	177.9	0.71
	U5-L6	-742.4	1359.5	1.33	-91.7	-154.8	0.89	1.15	1.71	2.23	-112.3	1.81	-133.7	1.52	-148.2	1.37	-166.3	1.22	-184.4	1.10
	L6-U7	-999.2	1901.8	1.33	-116.1	-204.3	1.04	1.35	1.94	2.52	-147.5	2.08	-178.5	1.72	-199.8	1.54	-234.9	1.31	-271.1	1.13
	U7-L8	804.6	1651.7	1.33	112.3	167.1	1.17	1.51	2.06	2.68	139.5	2.18	167.3	1.81	186.2	1.63	216.7	1.40	247.5	1.23
	L8-U9	-702.1	1571.7	1.33	-110.8	-147.2	1.35	1.75	2.27	2.95	-137.0	2.38	-164.0	1.99	-182.5	1.79	-210.7	1.55	-238.8	1.37
	U9-L10	502.6	856.5	1.33	94.4	108.2	0.56	0.72	1.16	1.51	116.1	0.92	138.6	0.77	153.8	0.70	175.3	0.61	196.7	0.55
	L10-U11	-303.7	626.9	1.33	-77.9	-75.1	0.79	1.02	1.39	1.81	-95.2	1.22	-113.3	1.03	-125.3	0.93	-140.0	0.83	-154.7	0.75
	U11-L12	97.5	575.2	1.33	61.5	48.1	1.99	2.58	2.83	3.68	74.3	2.87	87.8	2.43	96.6	2.21	104.7	2.04	112.6	1.89
					U9-L10		**0.56**	**0.72**	**1.16**	**1.51**	**U9-L10**	**0.92**	**U9-L10**	**0.77**	**U9-L10**	**0.70**	**U9-L10**	**0.61**	**U9-L10**	**0.55**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit Load
		Inventory	Operating	
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 5

					HL-93						STD. A		STD. B		STD. C		P411		P413	
					LOAD		STRENGTH I		SERVICE II		ST. II		ST. II		ST. II		ST. II		ST. II	
	Member	DL	Capacity	Impact	Truck	Lane	IRF	ORF	IRF	ORF	LL	RF	LL	RF	LL	RF	LL	RF	LL	RF
Lower Chord	L0-L1	76.1	548.1	1.33	71.4	72.3	1.55	2.01	2.17	2.82	87.3	2.44	104.0	2.05	115.3	1.85	129.4	1.65	143.5	1.48
	L1-L2	76.1	548.1	1.33	71.4	72.3	1.55	2.01	2.17	2.82	87.3	2.44	104.0	2.05	115.3	1.85	129.4	1.65	143.5	1.48
	L2-L3	-89.7	552.6	1.33	-87.5	-144.7	0.96	1.25	1.36	1.77	-108.8	1.90	-130.6	1.58	-145.7	1.42	-170.7	1.21	-195.1	1.06
	L3-L4	-89.7	552.6	1.33	-87.5	-144.7	0.96	1.25	1.36	1.77	-108.8	1.90	-130.6	1.58	-145.7	1.42	-170.7	1.21	-195.1	1.06
	L4-L5	-505.5	1216.9	1.33	-106.5	-176.2	1.05	1.36	1.72	2.24	-132.6	2.07	-159.1	1.73	-177.5	1.55	-208.0	1.32	-237.7	1.16
	L5-L6	-505.5	1216.9	1.33	-106.5	-176.2	1.05	1.36	1.72	2.24	-132.6	2.07	-159.1	1.73	-177.5	1.55	-208.0	1.32	-237.7	1.16
	L6-L7	-381.9	883.3	1.33	-63.9	-95.2	1.29	1.67	2.14	2.78	-79.3	2.40	-95.2	2.00	-105.9	1.80	-123.3	1.55	-140.8	1.35
	L7-L8	-381.9	883.3	1.33	-63.9	-95.2	1.29	1.67	2.14	2.78	-79.3	2.40	-95.2	2.00	-105.9	1.80	-123.3	1.55	-140.8	1.35
	L8-L9	401.9	812.1	1.33	76.2	101.3	0.87	1.13	1.56	2.03	94.3	1.54	112.8	1.29	125.5	1.16	144.9	1.00	164.2	0.89
	L9-L10	401.9	854.3	1.33	76.2	101.3	0.99	1.29	1.72	2.23	94.3	1.75	112.8	1.47	125.5	1.32	144.9	1.14	164.2	1.01
	L10-L11	863.6	2024.1	1.33	161.3	217.0	1.25	1.62	2.07	2.69	199.4	2.23	239.1	1.86	265.8	1.67	302.4	1.47	343.1	1.29
	L11-L12	863.6	2024.1	1.33	161.3	217.0	1.25	1.62	2.07	2.69	199.4	2.23	239.1	1.86	265.8	1.67	302.4	1.47	343.1	1.29
Upper Chord	U1-U2	-46.4	552.6	1.33	-112.8	-115.7	1.06	1.38	1.47	1.91	-138.3	1.68	-165.1	1.41	-182.5	1.27	-201.6	1.15	-222.9	1.04
	U2-U3	-46.4	552.6	1.33	-112.8	-115.7	1.06	1.38	1.47	1.91	-138.3	1.68	-165.1	1.41	-182.5	1.27	-201.6	1.15	-222.9	1.04
	U3-U4	288.4	854.3	1.33	100.4	165.9	0.94	1.22	1.45	1.89	124.9	1.86	149.8	1.55	167.1	1.39	195.9	1.18	223.9	1.04
	U4-U5	288.4	854.3	1.33	100.4	165.9	0.94	1.22	1.45	1.89	124.9	1.86	149.8	1.55	167.1	1.39	195.9	1.18	223.9	1.04
	U5-U6	857.8	2050.6	1.33	127.9	211.4	1.47	1.90	2.40	3.13	159.1	2.89	191.0	2.41	213.0	2.16	249.6	1.84	285.3	1.61
	U6-U7	857.8	2050.6	1.33	127.9	211.4	1.47	1.90	2.40	3.13	159.1	2.89	191.0	2.41	213.0	2.16	249.6	1.84	285.3	1.61
	U7-U8	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U9-U10	-689.6	1634.8	1.33	-129.8	-173.6	1.28	1.65	2.10	2.73	-160.5	2.26	-192.3	1.89	-214.0	1.70	-245.9	1.48	-277.0	1.31
	U10-U11	-689.6	1634.8	1.33	-129.8	-173.6	1.28	1.65	2.10	2.73	-160.5	2.26	-192.3	1.89	-214.0	1.70	-245.9	1.48	-277.0	1.31
	U11-U12	-918.8	2143.0	1.33	-171.1	-231.5	1.24	1.60	2.05	2.67	-211.4	2.21	-252.7	1.85	-280.7	1.67	-317.4	1.47	-361.0	1.29
Verticals	L1-U1	97.1	575.2	1.33	74.8	30.5	1.99	2.59	2.83	3.68	81.7	2.61	91.0	2.34	93.8	2.27	95.7	2.23	94.6	2.25
	L2-U2	-9.2	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L3-U3	98.4	838.9	1.33	74.8	30.5	3.15	4.08	4.38	5.69	81.7	4.12	91.0	3.69	93.8	3.58	95.7	3.51	94.6	3.55
	L4-U4	-9.6	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L5-U5	103.7	575.2	1.33	74.8	30.5	1.96	2.54	2.79	3.63	81.7	2.56	91.0	2.30	93.8	2.23	95.7	2.19	94.6	2.21
	L6-U6	-16.1	247.6	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L7-U7	101.4	575.2	1.33	74.8	30.5	1.97	2.55	2.80	3.64	81.7	2.58	91.0	2.31	93.8	2.25	95.7	2.20	94.6	2.23
	L8-U8	-8.0	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L9-U9	98.4	575.2	1.33	74.8	30.5	1.99	2.58	2.82	3.67	81.7	2.60	91.0	2.33	93.8	2.26	95.7	2.22	94.6	2.25
	L10-U10	-13.5	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L11-U11	102.9	847.1	1.33	74.8	30.5	3.16	4.09	4.40	5.72	81.7	4.13	91.0	3.71	93.8	3.60	95.7	3.53	94.6	3.57
	L12-U12	-9.7	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-110.7	731.9	1.33	-103.9	-105.2	1.39	1.81	1.96	2.55	-127.1	2.20	-151.3	1.84	-167.7	1.66	-188.2	1.48	-208.7	1.34
	U1-L2	-43.3	473.8	1.33	-42.4	-74.4	1.83	2.38	2.53	3.29	-52.8	3.74	-63.3	3.12	-70.6	2.79	-82.8	2.38	-94.6	2.08
	L2-U3	197.9	575.2	1.33	42.4	86.9	1.31	1.69	2.03	2.63	52.8	2.92	63.3	2.43	70.6	2.18	82.8	1.86	94.6	1.63
	U3-L4	-281.2	651.8	1.33	-78.7	-79.4	0.93	1.21	1.55	2.01	-94.1	1.50	-110.6	1.28	-120.8	1.17	-126.0	1.12	-129.5	1.09
	L4-U5	390.8	860.0	1.33	94.9	103.5	0.92	1.20	1.57	2.04	115.1	1.52	136.2	1.28	150.2	1.16	164.6	1.06	177.9	0.98
	U5-L6	-618.9	1359.5	1.33	-91.7	-154.8	1.21	1.57	2.06	2.68	-112.2	2.45	-133.6	2.06	-148.1	1.86	-166.2	1.66	-184.3	1.49
	L6-U7	-836.0	1901.8	1.33	-116.1	-204.3	1.36	1.77	2.29	2.97	-147.5	2.73	-178.5	2.26	-199.8	2.02	-234.9	1.71	-271.1	1.49
	U7-L8	671.0	1651.7	1.33	112.3	167.1	1.47	1.90	2.38	3.10	139.5	2.74	167.3	2.28	186.2	2.05	216.7	1.76	247.5	1.54
	L8-U9	-584.3	1571.7	1.33	-110.8	-147.2	1.63	2.12	2.58	3.35	-137.0	2.89	-164.0	2.41	-182.5	2.17	-210.7	1.88	-238.8	1.66
	U9-L10	418.3	856.5	1.33	94.4	108.2	0.82	1.06	1.44	1.88	116.1	1.35	138.6	1.13	153.8	1.02	175.3	0.89	196.7	0.80
	L10-U11	-253.0	626.9	1.33	-77.9	-75.1	0.99	1.29	1.61	2.09	-95.2	1.53	-113.3	1.29	-125.3	1.17	-140.0	1.04	-154.7	0.94
	U11-L12	80.3	575.2	1.33	61.5	48.1	2.09	2.71	2.93	3.81	74.3	3.00	87.8	2.54	96.6	2.31	104.7	2.13	112.6	1.98
					U9-L10		**0.82**	**1.06**	**1.36**	**1.77**	**U9-L10**	**1.35**	**U9-L10**	**1.13**	**U9-L10**	**1.02**	**U9-L10**	**0.89**	**U9-L10**	**0.80**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit
		Inventory	Operating	Load
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 6

					HL-93						STD. A		STD. B		STD. C		P411		P413	
					LOAD		STRENGTH I		SERVICE II		ST. II		ST. II		ST. II		ST. II		ST. II	
	Member	DL	Capacity	Impact	Truck	Lane	IRF	ORF	IRF	ORF	LL	RF	LL	RF	LL	RF	LL	RF	LL	RF
Lower Chord	L0-L1	71.0	548.1	1.33	84.9	85.9	1.32	1.71	1.85	2.40	101.1	2.14	118.0	1.83	129.4	1.67	143.8	1.50	158.1	1.37
	L1-L2	71.0	548.1	1.33	84.9	85.9	1.32	1.71	1.85	2.40	101.1	2.14	118.0	1.83	129.4	1.67	143.8	1.50	158.1	1.37
	L2-L3	-86.5	552.6	1.33	-104.0	-171.9	0.82	1.06	1.16	1.50	-125.7	1.66	-147.8	1.41	-163.1	1.28	-188.5	1.11	-213.3	0.98
	L3-L4	-86.5	552.6	1.33	-104.0	-171.9	0.82	1.06	1.16	1.50	-125.7	1.66	-147.8	1.41	-163.1	1.28	-188.5	1.11	-213.3	0.98
	L4-L5	-478.9	1216.9	1.33	-126.6	-209.4	0.94	1.21	1.50	1.95	-153.0	1.90	-179.9	1.61	-198.6	1.46	-229.5	1.27	-259.7	1.12
	L5-L6	-478.9	1216.9	1.33	-126.6	-209.4	0.94	1.21	1.50	1.95	-153.0	1.90	-179.9	1.61	-198.6	1.46	-229.5	1.27	-259.7	1.12
	L6-L7	-361.4	883.3	1.33	-75.9	-113.1	1.15	1.49	1.88	2.44	-91.7	2.21	-107.7	1.88	-118.7	1.71	-136.3	1.49	-154.1	1.32
	L7-L8	-361.4	883.3	1.33	-75.9	-113.1	1.15	1.49	1.88	2.44	-91.7	2.21	-107.7	1.88	-118.7	1.71	-136.3	1.49	-154.1	1.32
	L8-L9	380.0	812.1	1.33	90.5	120.3	0.80	1.04	1.38	1.80	108.8	1.46	127.7	1.24	140.6	1.13	160.3	0.99	179.9	0.88
	L9-L10	380.0	854.3	1.33	90.5	120.3	0.90	1.17	1.52	1.97	108.8	1.64	127.7	1.40	140.6	1.27	160.3	1.11	179.9	0.99
	L10-L11	816.7	2024.1	1.33	191.6	257.9	1.12	1.45	1.81	2.35	230.3	2.05	270.6	1.74	297.7	1.58	334.9	1.41	376.2	1.25
	L11-L12	816.7	2024.1	1.33	191.6	257.9	1.12	1.45	1.81	2.35	230.3	2.05	270.6	1.74	297.7	1.58	334.9	1.41	376.2	1.25
Upper Chord	U1-U2	-42.3	552.6	1.33	-134.0	-137.5	0.90	1.17	1.24	1.62	-160.0	1.47	-187.2	1.25	-204.9	1.15	-224.2	1.05	-245.9	0.96
	U2-U3	-42.3	552.6	1.33	-134.0	-137.5	0.90	1.17	1.24	1.62	-160.0	1.47	-187.2	1.25	-204.9	1.15	-224.2	1.05	-245.9	0.96
	U3-U4	274.0	854.3	1.33	119.2	197.1	0.82	1.07	1.25	1.63	144.2	1.67	169.5	1.42	187.1	1.29	216.3	1.11	244.7	0.98
	U4-U5	274.0	854.3	1.33	119.2	197.1	0.82	1.07	1.25	1.63	144.2	1.67	169.5	1.42	187.1	1.29	216.3	1.11	244.7	0.98
	U5-U6	812.2	2050.6	1.33	152.0	251.3	1.30	1.69	2.10	2.73	183.6	2.65	215.9	2.25	238.3	2.04	275.5	1.77	311.7	1.56
	U6-U7	812.2	2050.6	1.33	152.0	251.3	1.30	1.69	2.10	2.73	183.6	2.65	215.9	2.25	238.3	2.04	275.5	1.77	311.7	1.56
	U7-U8	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U9-U10	-652.1	1634.8	1.33	-154.2	-206.3	1.14	1.48	1.84	2.39	-185.4	2.08	-217.6	1.77	-239.7	1.61	-272.1	1.42	-303.7	1.27
	U10-U11	-652.1	1634.8	1.33	-154.2	-206.3	1.14	1.48	1.84	2.39	-185.4	2.08	-217.6	1.77	-239.7	1.61	-272.1	1.42	-303.7	1.27
	U11-U12	-868.8	2143.0	1.33	-203.3	-275.0	1.11	1.44	1.80	2.34	-244.1	2.04	-286.1	1.74	-314.5	1.58	-351.8	1.41	-395.6	1.26
Verticals	L1-U1	90.5	575.2	1.33	88.9	36.3	1.71	2.22	2.41	3.14	95.9	2.26	105.3	2.06	108.2	2.01	110.1	1.97	109.0	1.99
	L2-U2	-9.2	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L3-U3	91.8	838.9	1.33	88.9	36.3	2.68	3.47	3.72	4.83	95.9	3.55	105.3	3.23	108.2	3.14	110.1	3.09	109.0	3.12
	L4-U4	-9.6	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L5-U5	97.1	575.2	1.33	88.9	36.3	1.68	2.18	2.38	3.09	95.9	2.22	105.3	2.02	108.2	1.97	110.1	1.94	109.0	1.96
	L6-U6	-16.1	247.6	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L7-U7	94.9	575.2	1.33	88.9	36.3	1.69	2.19	2.39	3.11	95.9	2.24	105.3	2.04	108.2	1.98	110.1	1.95	109.0	1.97
	L8-U8	-8.0	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L9-U9	91.8	575.2	1.33	88.9	36.3	1.70	2.21	2.41	3.13	95.9	2.26	105.3	2.05	108.2	2.00	110.1	1.96	109.0	1.98
	L10-U10	-13.5	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L11-U11	96.3	847.1	1.33	88.9	36.3	2.69	3.48	3.74	4.86	95.9	3.56	105.3	3.24	108.2	3.16	110.1	3.10	109.0	3.13
	L12-U12	-9.7	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-103.2	731.9	1.33	-123.5	-125.0	1.19	1.54	1.67	2.17	-146.9	1.93	-171.5	1.65	-188.2	1.51	-209.0	1.36	-229.8	1.23
	U1-L2	-41.7	473.8	1.33	-50.4	-88.3	1.55	2.01	2.14	2.78	-60.9	3.25	-71.6	2.77	-79.1	2.51	-91.4	2.17	-103.4	1.92
	L2-U3	187.3	575.2	1.33	50.4	103.3	1.14	1.48	1.75	2.28	60.9	2.63	71.6	2.24	79.1	2.03	91.4	1.75	103.4	1.55
	U3-L4	-265.3	651.8	1.33	-93.5	-94.4	0.84	1.08	1.36	1.77	-109.1	1.38	-125.8	1.20	-136.2	1.10	-141.5	1.06	-145.0	1.04
	L4-U5	368.8	860.0	1.33	112.8	122.9	0.84	1.08	1.38	1.80	133.3	1.41	154.8	1.21	169.0	1.11	183.5	1.02	197.0	0.95
	U5-L6	-585.5	1359.5	1.33	-109.0	-183.9	1.09	1.41	1.81	2.35	-129.8	2.27	-151.5	1.95	-166.2	1.77	-184.6	1.60	-202.9	1.45
	L6-U7	-792.0	1901.8	1.33	-138.0	-242.8	1.22	1.58	2.00	2.60	-169.8	2.52	-201.2	2.13	-222.9	1.92	-258.5	1.66	-295.3	1.45
	U7-L8	634.9	1651.7	1.33	133.5	198.6	1.30	1.69	2.08	2.70	161.0	2.50	189.2	2.13	208.4	1.93	239.4	1.68	270.6	1.49
	L8-U9	-552.5	1571.7	1.33	-131.7	-175.0	1.44	1.86	2.24	2.91	-158.2	2.62	-185.6	2.23	-204.3	2.03	-233.0	1.78	-261.5	1.58
	U9-L10	395.6	856.5	1.33	112.1	128.6	0.74	0.97	1.28	1.66	134.1	1.27	157.0	1.08	172.4	0.99	194.3	0.88	216.0	0.79
	L10-U11	-239.4	626.9	1.33	-92.6	-89.2	0.88	1.14	1.40	1.82	-110.1	1.40	-128.4	1.20	-140.6	1.10	-155.6	0.99	-170.5	0.90
	U11-L12	75.7	575.2	1.33	73.1	57.1	1.78	2.31	2.49	3.24	85.9	2.63	99.7	2.26	108.6	2.08	116.8	1.93	124.9	1.81
					U9-L10		**0.74**	**0.97**	**1.16**	**1.50**	**U9-L10**	**1.27**	**U9-L10**	**1.08**	**U9-L10**	**0.99**	**U9-L10**	**0.88**	**U9-L10**	**0.79**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit Load
		Inventory	Operating	
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 9

	Member	DL	Capacity	Impact	HL-93 Truck + Lane*	STRENGTH I IRF	STRENGTH I ORF	SERVICE II IRF	SERVICE II ORF
Lower Chord	L0-L1	87.4	548.1	1.33	59.9	3.15	4.08	4.45	5.79
	L1-L2	105.9	548.1	1.33	38.9	4.59	5.95	6.58	8.55
	L2-L3	-27.7	552.6	1.33	-45.9	4.85	6.28	6.61	8.59
	L3-L4	26.5	854.3	1.33	61.0	5.78	7.49	7.85	10.20
	L4-L5	-382.8	1216.9	1.33	-73.6	4.31	5.59	6.56	8.52
	L5-L6	-371.2	1216.9	1.33	-74.5	4.34	5.63	6.57	8.54
	L6-L7	-251.6	883.3	1.33	-54.5	4.48	5.81	6.70	8.71
	L7-L8	-344.1	883.3	1.33	-75.2	2.59	3.36	4.15	5.39
	L8-L9	308.7	812.1	1.33	79.1	2.31	3.00	3.68	4.78
	L9-L10	129.7	854.3	1.33	48.2	6.17	7.99	8.69	11.30
	L10-L11	501.9	2024.1	1.33	117.1	5.12	6.64	7.52	9.77
	L11-L12	445.4	2024.1	1.33	107.1	5.89	7.63	8.52	11.08
Upper Chord	U1-U2	-48.3	552.6	1.33	-121.9	1.73	2.25	2.39	3.11
	U2-U3	-46.8	552.6	1.33	-122.2	1.74	2.25	2.39	3.11
	U3-U4	325.9	854.3	1.33	137.3	1.40	1.81	2.23	2.89
	U4-U5	325.5	854.3	1.33	142.2	1.35	1.75	2.15	2.80
	U5-U6	1028.0	2050.6	1.33	200.3	1.64	2.13	2.95	3.84
	U6-U7	1028.1	2050.6	1.33	200.6	1.64	2.13	2.95	3.83
	U7-U8	0.0	548.1	1.33	-0.1				
	U8-U9	-0.3	346.9	1.33	0.0				
	U9-U10	-803.2	1634.8	1.33	-170.1	1.59	2.07	2.83	3.68
	U10-U11	-807.5	1634.8	1.33	-165.8	1.62	2.10	2.89	3.75
	U11-U12	-1094.6	2143.0	1.33	-220.9	1.51	1.95	2.75	3.57
Verticals	L1-U1	118.9	575.2	1.33	68.3	2.68	3.48	3.87	5.02
	L2-U2	-8.7	342.8	1.33	-0.3				
	L3-U3	121.1	838.9	1.33	66.1	4.47	5.79	6.28	8.17
	L4-U4	-8.9	284.5	1.33	-0.2				
	L5-U5	129.0	575.2	1.33	66.8	2.66	3.45	3.87	5.03
	L6-U6	-22.4	247.6	1.33	-1.0				
	L7-U7	126.4	575.2	1.33	68.4	2.62	3.40	3.79	4.93
	L8-U8	-590.0	284.5	1.33	-112.8				
	L9-U9	141.7	575.2	1.33	71.8	2.38	3.09	3.49	4.54
	L10-U10	-9.4	342.8	1.33	-0.1				
	L11-U11	110.3	847.1	1.33	65.0	4.69	6.08	6.56	8.53
	L12-U12	-12.5	342.8	1.33	0.0				
Diagonals	L0-U1	-132.2	731.9	1.33	-121.2	2.01	2.60	2.86	3.72
	U1-L2	-55.3	473.8	1.33	-59.5	2.92	3.79	4.07	5.29
	L2-U3	241.6	575.2	1.33	73.3	1.60	2.07	2.63	3.42
	U3-L4	-339.9	651.8	1.33	-92.7	1.05	1.36	1.95	2.53
	L4-U5	466.1	860.0	1.33	119.0	1.00	1.30	1.92	2.49
	U5-L6	-745.1	1359.5	1.33	-145.5	1.26	1.64	2.44	3.18
	L6-U7	-1008.2	1901.8	1.33	-191.9	1.44	1.86	2.69	3.50
	U7-L8	807.6	1651.7	1.33	165.6	1.67	2.16	2.95	3.83
	L8-U9	-719.4	1571.7	1.33	-156.3	1.85	2.40	3.15	4.10
	U9-L10	487.2	856.5	1.33	113.4	0.94	1.22	1.88	2.45
	L10-U11	-303.9	626.9	1.33	-89.5	1.19	1.54	2.09	2.71
	U11-L12	112.6	575.2	1.33	69.9	2.67	3.46	3.83	4.97
					U9-L10	**0.94**	**1.22**	**1.88**	**2.45**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit Load
		Inventory	Operating	
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 10

					HL-93						STD. A		STD. B		STD. C		P411		P413	
					LOAD		STRENGTH I		SERVICE II		ST. II		ST. II		ST. II		ST. II		ST. II	
	Member	DL	Capacity	Impact	Truck	Lane	IRF	ORF	IRF	ORF	LL	RF	LL	RF	LL	RF	LL	RF	LL	RF
Lower Chord	L0-L1	123.9	548.1	1.33	71.4	72.3	1.34	1.74	1.95	2.54	87.3	2.12	104.0	1.78	115.3	1.60	129.4	1.43	143.5	1.29
	L1-L2	123.9	548.1	1.33	71.4	72.3	1.34	1.74	1.95	2.54	87.3	2.12	104.0	1.78	115.3	1.60	129.4	1.43	143.5	1.29
	L2-L3	-118.3	552.6	1.33	-87.5	-144.7	0.89	1.15	1.28	1.66	-108.8	1.75	-130.6	1.46	-145.7	1.31	-170.7	1.11	-195.1	0.97
	L3-L4	-118.3	552.6	1.33	-87.5	-144.7	0.89	1.15	1.28	1.66	-108.8	1.75	-130.6	1.46	-145.7	1.31	-170.7	1.11	-195.1	0.97
	L4-L5	-749.5	1216.9	1.33	-106.5	-176.2	0.50	0.65	1.13	1.47	-132.6	0.99	-159.1	0.83	-177.5	0.74	-208.0	0.63	-237.7	0.55
	L5-L6	-749.5	1216.9	1.33	-106.5	-176.2	0.50	0.65	1.13	1.47	-132.6	0.99	-159.1	0.83	-177.5	0.74	-208.0	0.63	-237.7	0.55
	L6-L7	-570.2	883.3	1.33	-63.9	-95.2	0.54	0.70	1.34	1.74	-79.3	1.01	-95.2	0.84	-105.9	0.76	-123.3	0.65	-140.8	0.57
	L7-L8	-570.2	883.3	1.33	-63.9	-95.2	0.54	0.70	1.34	1.74	-79.3	1.01	-95.2	0.84	-105.9	0.76	-123.3	0.65	-140.8	0.57
	L8-L9	602.2	812.1	1.33	76.2	101.3	0.17	0.22	0.80	1.04	94.3	0.30	112.8	0.25	125.5	0.22	144.9	0.19	164.2	0.17
	L9-L10	602.2	854.3	1.33	76.2	101.3	0.29	0.37	0.96	1.24	94.3	0.51	112.8	0.42	125.5	0.38	144.9	0.33	164.2	0.29
	L10-L11	1292.9	2024.1	1.33	161.3	217.0	0.54	0.70	1.30	1.69	199.4	0.96	239.1	0.80	265.8	0.72	302.4	0.63	343.1	0.56
	L11-L12	1292.9	2024.1	1.33	161.3	217.0	0.54	0.70	1.30	1.69	199.4	0.96	239.1	0.80	265.8	0.72	302.4	0.63	343.1	0.56
Upper Chord	U1-U2	-84.6	552.6	1.33	-112.8	-115.7	0.96	1.25	1.35	1.76	-138.3	1.52	-165.1	1.27	-182.5	1.15	-201.6	1.04	-222.9	0.94
	U2-U3	-84.6	552.6	1.33	-112.8	-115.7	0.96	1.25	1.35	1.76	-138.3	1.52	-165.1	1.27	-182.5	1.15	-201.6	1.04	-222.9	0.94
	U3-U4	419.7	854.3	1.33	100.4	165.9	0.63	0.82	1.12	1.45	124.9	1.24	149.8	1.03	167.1	0.93	195.9	0.79	223.9	0.69
	U4-U5	419.7	854.3	1.33	100.4	165.9	0.63	0.82	1.12	1.45	124.9	1.24	149.8	1.03	167.1	0.93	195.9	0.79	223.9	0.69
	U5-U6	1276.1	2050.6	1.33	127.9	211.4	0.68	0.88	1.56	2.03	159.1	1.35	191.0	1.12	213.0	1.01	249.6	0.86	285.3	0.75
	U6-U7	1276.1	2050.6	1.33	127.9	211.4	0.68	0.88	1.56	2.03	159.1	1.35	191.0	1.12	213.0	1.01	249.6	0.86	285.3	0.75
	U7-U8	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U9-U10	-1033.0	1634.8	1.33	-129.8	-173.6	0.57	0.74	1.34	1.74	-160.5	1.01	-192.3	0.84	-214.0	0.75	-245.9	0.66	-277.0	0.58
	U10-U11	-1033.0	1634.8	1.33	-129.8	-173.6	0.57	0.74	1.34	1.74	-160.5	1.01	-192.3	0.84	-214.0	0.75	-245.9	0.66	-277.0	0.58
	U11-U12	-1376.7	2143.0	1.33	-171.1	-231.5	0.53	0.68	1.28	1.67	-211.4	0.94	-252.7	0.79	-280.7	0.71	-317.4	0.63	-360.5	0.55
Verticals	L1-U1	157.5	575.2	1.33	74.8	30.5	1.66	2.16	2.47	3.21	81.7	2.17	91.0	1.95	93.8	1.89	95.7	1.86	94.6	1.88
	L2-U2	-9.2	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L3-U3	158.8	838.9	1.33	74.8	30.5	2.81	3.65	4.02	5.23	81.7	3.68	91.0	3.31	93.8	3.21	95.7	3.14	94.6	3.18
	L4-U4	-9.6	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L5-U5	164.1	575.2	1.33	74.8	30.5	1.63	2.11	2.43	3.16	81.7	2.13	91.0	1.91	93.8	1.85	95.7	1.82	94.6	1.84
	L6-U6	-16.1	247.6	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L7-U7	161.9	575.2	1.33	74.8	30.5	1.64	2.12	2.45	3.18	81.7	2.14	91.0	1.92	93.8	1.87	95.7	1.83	94.6	1.85
	L8-U8	-8.0	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L9-U9	158.9	575.2	1.33	74.8	30.5	1.66	2.15	2.46	3.20	81.7	2.16	91.0	1.94	93.8	1.89	95.7	1.85	94.6	1.87
	L10-U10	-13.5	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L11-U11	163.3	847.1	1.33	74.8	30.5	2.83	3.66	4.05	5.26	81.7	3.70	91.0	3.32	93.8	3.22	95.7	3.16	94.6	3.19
	L12-U12	-9.7	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-180.1	731.9	1.33	-103.9	-105.2	1.19	1.54	1.74	2.27	-127.1	1.87	-151.3	1.57	-167.7	1.42	-188.2	1.27	-208.7	1.14
	L1-L2	-57.1	473.8	1.33	-42.4	-74.4	1.76	2.28	2.45	3.19	-52.8	3.58	-63.3	2.99	-70.6	2.68	-82.8	2.28	-94.6	2.00
	L2-U3	295.0	575.2	1.33	42.4	86.9	0.82	1.07	1.50	1.96	52.8	1.84	63.3	1.53	70.6	1.37	82.8	1.17	94.6	1.03
	L3-L4	-427.0	651.8	1.33	-78.7	-79.4	0.37	0.48	0.94	1.22	-94.1	0.59	-110.6	0.50	-120.8	0.46	-126.0	0.44	-129.5	0.43
	L4-U5	593.1	860.0	1.33	94.9	103.5	0.30	0.38	0.89	1.16	115.1	0.48	136.2	0.41	150.2	0.37	164.6	0.34	177.9	0.31
	L5-L6	-925.1	1359.5	1.33	-91.7	-154.8	0.42	0.54	1.21	1.57	-112.2	0.85	-133.6	0.71	-148.1	0.64	-166.2	0.57	-184.3	0.52
	L6-U7	-1240.2	1901.8	1.33	-116.1	-203.8	0.56	0.73	1.42	1.85	-147.5	1.12	-178.5	0.93	-199.8	0.83	-234.9	0.70	-271.1	0.61
	U7-L8	1001.7	1651.7	1.33	112.3	167.1	0.72	0.94	1.58	2.05	139.5	1.35	167.3	1.12	186.2	1.01	216.7	0.87	247.5	0.76
	L8-U9	-875.6	1571.7	1.33	-110.8	-147.2	0.93	1.20	1.82	2.36	-137.0	1.64	-164.0	1.37	-182.5	1.23	-210.7	1.06	-238.8	0.94
	U9-L10	626.4	856.5	1.33	94.4	108.2	0.18	0.23	0.76	0.98	116.1	0.30	138.6	0.25	153.8	0.22	175.3	0.20	196.7	0.18
	L10-U11	-377.8	626.9	1.33	-77.9	-75.1	0.49	0.64	1.07	1.39	-95.2	0.76	-113.3	0.64	-125.3	0.58	-140.0	0.52	-154.7	0.47
	U11-L12	121.9	575.2	1.33	61.5	48.1	1.86	2.41	2.68	3.49	74.3	2.68	87.8	2.26	96.6	2.06	104.7	1.90	112.6	1.77
					L8-L9		0.17	0.22	0.76	0.98	L8-L9	0.30	L8-L9	0.25	L8-L9	0.22	L8-L9	0.19	L8-L9	0.17

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit Load
		Inventory	Operating	
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 10A

	Member	DL	Capacity	Impact	HS20-44 LL	HS20-44 IRF	HS20-44 ORF	STD. A LL	STD. A ORF	STD. B LL	STD. B ORF	STD. C LL	STD. C ORF	P411 LL	P411 ORF	P413 LL	P413 ORF
Lower Chord	L0-L1	123.9	674.8	1.15	90.9	2.27	3.78	87.3	3.93	104.0	3.30	115.3	2.98	129.4	2.65	143.5	2.39
	L1-L2	123.9	674.8	1.15	90.9	2.27	3.78	87.3	3.93	104.0	3.30	115.3	2.98	129.4	2.65	143.5	2.39
	L2-L3	-118.3	709.9	1.11	-167.5	1.38	2.30	-108.8	3.54	-130.6	2.95	-145.7	2.64	-170.7	2.25	-195.1	1.97
	L3-L4	-118.3	709.9	1.11	-167.5	1.38	2.30	-108.8	3.54	-130.6	2.95	-145.7	2.64	-170.7	2.25	-195.1	1.97
	L4-L5	-749.5	1518.8	1.11	-204.0	1.11	1.85	-132.6	2.84	-159.1	2.37	-177.5	2.12	-208.0	1.81	-237.7	1.58
	L5-L6	-749.5	1518.8	1.11	-204.0	1.11	1.85	-132.6	2.84	-159.1	2.37	-177.5	2.12	-208.0	1.81	-237.7	1.58
	L6-L7	-570.2	1106.1	1.11	-111.8	1.35	2.26	-79.3	3.18	-95.2	2.65	-105.9	2.38	-123.3	2.05	-140.8	1.79
	L7-L8	-570.2	1106.1	1.11	-111.8	1.35	2.26	-79.3	3.18	-95.2	2.65	-105.9	2.38	-123.3	2.05	-140.8	1.79
	L8-L9	602.2	1236.0	1.09	121.0	1.58	2.64	94.3	3.39	112.8	2.83	125.5	2.54	144.9	2.20	164.2	1.94
	L9-L10	602.2	1236.0	1.09	121.0	1.58	2.64	94.3	3.39	112.8	2.83	125.5	2.54	144.9	2.20	164.2	1.94
	L10-L11	1292.9	2750.5	1.09	259.4	1.74	2.91	199.4	3.78	239.1	3.15	265.8	2.84	302.4	2.49	343.1	2.20
	L11-L12	1292.9	2750.5	1.09	259.4	1.74	2.91	199.4	3.78	239.1	3.15	265.8	2.84	302.4	2.49	343.1	2.20
Upper Chord	U1-U2	-84.6	709.9	1.15	-145.5	1.65	2.75	-138.3	2.90	-165.1	2.43	-182.5	2.20	-201.6	1.99	-222.9	1.80
	U2-U3	-84.6	709.9	1.15	-145.5	1.65	2.75	-138.3	2.90	-165.1	2.43	-182.5	2.20	-201.6	1.99	-222.9	1.80
	U3-U4	419.7	1236.0	1.11	192.1	1.49	2.49	124.9	3.82	149.8	3.19	167.1	2.86	195.9	2.44	223.9	2.13
	U4-U5	419.7	1236.0	1.11	192.1	1.49	2.49	124.9	3.82	149.8	3.19	167.1	2.86	195.9	2.44	223.9	2.13
	U5-U6	1276.1	2524.6	1.11	244.8	1.47	2.45	159.1	3.77	191.0	3.14	213.0	2.81	249.6	2.40	285.3	2.10
	U6-U7	1276.1	2524.6	1.11	244.8	1.47	2.45	159.1	3.77	191.0	3.14	213.0	2.81	249.6	2.40	285.3	2.10
	U7-U8	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U9-U10	-1033.0	1922.7	1.09	-207.5	1.18	1.97	-160.5	2.55	-192.3	2.13	-214.0	1.91	-245.9	1.66	-277.0	1.48
	U10-U11	-1033.0	1922.7	1.09	-207.5	1.18	1.97	-160.5	2.55	-192.3	2.13	-214.0	1.91	-245.9	1.66	-277.0	1.48
	U11-U12	-1376.7	2533.1	1.09	-276.6	1.14	1.89	-211.4	2.48	-252.7	2.07	-280.7	1.87	-317.4	1.65	-360.5	1.45
Verticals	L1-U1	157.5	708.2	1.25	75.0	2.47	4.12	81.7	3.78	91.0	3.40	93.8	3.30	95.7	3.23	94.6	3.27
	L2-U2	-9.2	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L3-U3	158.8	1278.0	1.25	75.0	5.26	8.77	81.7	8.05	91.0	7.23	93.8	7.02	95.7	6.88	94.6	6.96
	L4-U4	-9.6	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L5-U5	164.1	708.2	1.25	75.0	2.43	4.05	81.7	3.72	91.0	3.34	93.8	3.24	95.7	3.18	94.6	3.21
	L6-U6	-16.1	314.2	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L7-U7	161.9	708.2	1.25	75.0	2.45	4.08	81.7	3.74	91.0	3.36	93.8	3.26	95.7	3.19	94.6	3.23
	L8-U8	-8.0	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L9-U9	158.9	708.2	1.25	75.0	2.46	4.11	81.7	3.77	91.0	3.39	93.8	3.28	95.7	3.22	94.6	3.26
	L10-U10	-13.5	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L11-U11	163.3	1278.0	1.25	75.0	5.24	8.73	81.7	8.01	91.0	7.19	93.8	6.98	95.7	6.84	94.6	6.92
	L12-U12	-9.7	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-180.1	910.1	1.15	-144.3	1.88	3.13	-127.1	3.55	-151.3	2.98	-167.7	2.69	-188.2	2.40	-208.7	2.16
	U1-L2	-57.1	579.0	1.30	-90.0	1.99	3.31	-52.8	5.65	-63.3	4.71	-70.6	4.22	-82.8	3.60	-94.6	3.15
	L2-U3	295.0	708.2	1.24	102.5	1.18	1.96	52.8	3.81	63.3	3.18	70.6	2.85	82.8	2.43	94.6	2.13
	U3-L4	-427.0	814.1	1.19	-110.6	0.91	1.51	-94.1	1.78	-110.6	1.51	-120.8	1.38	-126.0	1.33	-129.5	1.29
	L4-U5	593.1	1278.0	1.17	139.6	1.43	2.38	115.1	2.89	136.2	2.44	150.2	2.22	164.6	2.02	177.9	1.87
	U5-L6	-925.1	1731.0	1.15	-189.1	1.12	1.87	-112.2	3.15	-133.6	2.64	-148.1	2.38	-166.2	2.12	-184.3	1.91
	L6-U7	-1240.2	2394.7	1.10	-246.8	1.33	2.21	-147.5	3.70	-178.5	3.06	-199.8	2.73	-234.9	2.33	-271.1	2.02
	U7-L8	1001.7	2061.8	1.11	209.4	1.51	2.51	139.5	3.77	167.3	3.14	186.2	2.82	216.7	2.43	247.5	2.12
	L8-U9	-875.6	1959.5	1.12	-189.0	1.79	2.98	-137.0	4.11	-164.0	3.43	-182.5	3.09	-210.7	2.67	-238.8	2.36
	U9-L10	626.4	1278.0	1.13	144.3	1.31	2.18	116.1	2.72	138.6	2.27	153.8	2.05	175.3	1.80	196.7	1.60
	L10-U11	-377.8	784.5	1.15	-104.9	1.12	1.87	-95.2	2.06	-113.3	1.73	-125.3	1.56	-140.0	1.40	-154.7	1.27
	U11-L12	121.9	708.2	1.17	72.0	3.01	5.01	74.3	4.86	87.8	4.11	96.6	3.74	104.7	3.45	112.6	3.21
					U3-L4	**0.91**	**1.51**	**U3-L4**	**1.78**	**U3-L4**	**1.51**	**U3-L4**	**1.38**	**U3-L4**	**1.33**	**L10-U11**	**1.27**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Truss Member Results – Analysis 12

					HL-93						STD. A		STD. B		STD. C		P411		P413	
					LOAD		STRENGTH I		SERVICE II		ST. II		ST. II		ST. II		ST. II		ST. II	
	Member	DL	Capacity	Impact	Truck	Lane	IRF	ORF	IRF	ORF	LL	RF	LL	RF	LL	RF	LL	RF	LL	RF
Lower Chord	L0-L1	104.6	548.1	1.33	71.4	72.3	1.43	1.85	2.04	2.65	87.3	2.25	104.0	1.89	115.3	1.70	129.4	1.52	143.5	1.37
	L1-L2	104.6	548.1	1.33	71.4	72.3	1.43	1.85	2.04	2.65	87.3	2.25	104.0	1.89	115.3	1.70	129.4	1.52	143.5	1.37
	L2-L3	-106.8	552.6	1.33	-87.5	-144.7	0.92	1.19	1.31	1.71	-108.8	1.81	-130.6	1.51	-145.7	1.35	-170.7	1.15	-195.1	1.01
	L3-L4	-106.8	552.6	1.33	-87.5	-144.7	0.92	1.19	1.31	1.71	-108.8	1.81	-130.6	1.51	-145.7	1.35	-170.7	1.15	-195.1	1.01
	L4-L5	-651.2	1216.9	1.33	-106.5	-176.2	0.72	0.94	1.37	1.78	-132.6	1.43	-159.1	1.19	-177.5	1.07	-208.0	0.91	-237.7	0.80
	L5-L6	-651.2	1216.9	1.33	-106.5	-176.2	0.72	0.94	1.37	1.78	-132.6	1.43	-159.1	1.19	-177.5	1.07	-208.0	0.91	-237.7	0.80
	L6-L7	-494.3	883.3	1.33	-63.9	-95.2	0.84	1.09	1.66	2.16	-79.3	1.57	-95.2	1.31	-105.9	1.18	-123.3	1.01	-140.8	0.89
	L7-L8	-494.3	883.3	1.33	-63.9	-95.2	0.84	1.09	1.66	2.16	-79.3	1.57	-95.2	1.31	-105.9	1.18	-123.3	1.01	-140.8	0.89
	L8-L9	521.5	812.1	1.33	76.2	101.3	0.45	0.59	1.10	1.43	94.3	0.80	112.8	0.67	125.5	0.60	144.9	0.52	164.2	0.46
	L9-L10	521.5	854.3	1.33	76.2	101.3	0.57	0.74	1.26	1.64	94.3	1.01	112.8	0.84	125.5	0.76	144.9	0.66	164.2	0.58
	L10-L11	1119.9	2024.1	1.33	161.3	217.0	0.83	1.07	1.61	2.10	199.4	1.47	239.1	1.23	265.8	1.10	302.4	0.97	343.1	0.85
	L11-L12	1119.9	2024.1	1.33	161.3	217.0	0.83	1.07	1.61	2.10	199.4	1.47	239.1	1.23	265.8	1.10	302.4	0.97	343.1	0.85
Upper Chord	U1-U2	-69.2	552.6	1.33	-112.8	-115.7	1.00	1.30	1.40	1.82	-138.3	1.58	-165.1	1.33	-182.5	1.20	-201.6	1.09	-222.9	0.98
	U2-U3	-69.2	552.6	1.33	-112.8	-115.7	1.00	1.30	1.40	1.82	-138.3	1.58	-165.1	1.33	-182.5	1.20	-201.6	1.09	-222.9	0.98
	U3-U4	366.8	854.3	1.33	100.4	165.9	0.76	0.98	1.25	1.63	124.9	1.49	149.8	1.24	167.1	1.11	195.9	0.95	223.9	0.83
	U4-U5	336.8	854.3	1.33	100.4	165.9	0.83	1.07	1.33	1.73	124.9	1.63	149.8	1.36	167.1	1.22	195.9	1.04	223.9	0.91
	U5-U6	1107.6	2050.6	1.33	127.9	211.4	1.00	1.29	1.90	2.47	159.1	1.97	191.0	1.64	213.0	1.47	249.6	1.25	285.3	1.10
	U6-U7	1107.6	2050.6	1.33	127.9	211.4	1.00	1.29	1.90	2.47	159.1	1.97	191.0	1.64	213.0	1.47	249.6	1.25	285.3	1.10
	U7-U8	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	548.1	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	U9-U10	-894.6	1634.8	1.33	-129.8	-173.6	0.85	1.11	1.64	2.14	-160.5	1.51	-192.3	1.26	-214.0	1.13	-245.9	0.99	-277.0	0.88
	U10-U11	-894.6	1634.8	1.33	-129.8	-173.6	0.85	1.11	1.64	2.14	-160.5	1.51	-192.3	1.26	-214.0	1.13	-245.9	0.99	-277.0	0.88
	U11-U12	-1192.2	2143.0	1.33	-171.1	-231.5	0.81	1.05	1.59	2.07	-211.4	1.45	-252.7	1.21	-280.7	1.09	-317.4	0.97	-360.5	0.85
Verticals	L1-U1	133.1	575.2	1.33	74.8	30.5	1.80	2.33	2.62	3.40	81.7	2.35	91.0	2.11	93.8	2.05	95.7	2.01	94.6	2.03
	L2-U2	-9.2	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L3-U3	134.5	838.9	1.33	74.8	30.5	2.95	3.82	4.17	5.42	81.7	3.86	91.0	3.46	93.8	3.36	95.7	3.29	94.6	3.33
	L4-U4	-9.6	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L5-U5	139.8	575.2	1.33	74.8	30.5	1.76	2.28	2.58	3.35	81.7	2.30	91.0	2.07	93.8	2.01	95.7	1.97	94.6	1.99
	L6-U6	-16.1	247.6	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L7-U7	137.5	575.2	1.33	74.8	30.5	1.77	2.30	2.59	3.37	81.7	2.32	91.0	2.08	93.8	2.02	95.7	1.98	94.6	2.00
	L8-U8	-8.0	284.5	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L9-U9	134.5	575.2	1.33	74.8	30.5	1.79	2.32	2.61	3.39	81.7	2.34	91.0	2.10	93.8	2.04	95.7	2.00	94.6	2.02
	L10-U10	-13.5	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
	L11-U11	139.0	847.1	1.33	74.8	30.5	2.96	3.84	4.19	5.45	81.7	3.87	91.0	3.48	93.8	3.37	95.7	3.30	94.6	3.34
	L12-U12	-9.7	342.8	1.33	0.0	0.0					0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-152.1	731.9	1.33	-103.9	-105.2	1.27	1.65	1.83	2.38	-127.1	2.00	-151.3	1.68	-167.7	1.52	-188.2	1.35	-208.7	1.22
	L1-L2	-51.5	473.8	1.33	-42.4	-74.4	1.79	2.32	2.48	3.23	-52.8	3.64	-63.3	3.04	-70.6	2.73	-82.8	2.32	-94.6	2.03
	L2-U3	255.9	575.2	1.33	42.4	86.9	1.02	1.32	1.71	2.23	52.8	2.27	63.3	1.90	70.6	1.70	82.8	1.45	94.6	1.27
	U3-L4	-368.3	651.8	1.33	-78.7	-79.4	0.59	0.77	1.18	1.54	-94.1	0.96	-110.6	0.81	-120.8	0.75	-126.0	0.71	-129.5	0.70
	L4-U5	511.6	860.0	1.33	94.9	103.5	0.55	0.71	1.17	1.52	115.1	0.90	136.2	0.76	150.2	0.69	164.6	0.63	177.9	0.58
	U5-L6	-801.7	1359.5	1.33	-91.7	-154.8	0.74	0.96	1.55	2.01	-112.2	1.50	-133.6	1.26	-148.1	1.13	-166.2	1.01	-184.3	0.91
	L6-U7	-1077.4	1901.8	1.33	-116.1	-203.8	0.89	1.15	1.77	2.30	-147.5	1.77	-178.5	1.46	-199.8	1.31	-234.9	1.11	-271.1	0.96
	U7-L8	868.5	1651.7	1.33	112.3	167.1	1.02	1.32	1.90	2.47	139.5	1.91	167.3	1.59	186.2	1.43	216.7	1.23	247.5	1.08
	L8-U9	-758.3	1571.7	1.33	-110.8	-147.2	1.21	1.57	2.12	2.76	-137.0	2.14	-164.0	1.79	-182.5	1.61	-210.7	1.39	-238.8	1.23
	U9-L10	542.6	856.5	1.33	94.4	108.2	0.44	0.56	1.03	1.34	116.1	0.72	138.6	0.60	153.8	0.54	175.3	0.48	196.7	0.43
	L10-U11	-327.6	626.9	1.33	-77.9	-75.1	0.70	0.90	1.29	1.67	-95.2	1.07	-113.3	0.90	-125.3	0.82	-140.0	0.73	-154.7	0.66
	U11-L12	105.1	575.2	1.33	61.5	48.1	1.95	2.53	2.78	3.62	74.3	2.81	87.8	2.38	96.6	2.16	104.7	1.99	112.6	1.85
					U9-L10		**0.44**	**0.56**	**1.03**	**1.34**	**U9-L10**	**0.72**	**U9-L10**	**0.60**	**U9-L10**	**0.54**	**U9-L10**	**0.48**	**U9-L10**	**0.43**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

		Design Load		Permit
		Inventory	Operating	Load
	γ_{DC}	γ_{LL}	γ_{LL}	γ_{LL}
Strength I	1.25	1.75	1.35	---
Strength II	1.25	---	---	1.60
Service II	1.00	1.30	1.00	---

ϕ_C	ϕ_S	max ($\phi_C \cdot \phi_S$, 0.85)
0.95	0.90	0.86

Truss Member Results – Analysis 12A

	Member	DL	Capacity	Impact	HS20-44 LL	HS20-44 IRF	HS20-44 ORF	STD. A LL	STD. A ORF	STD. B LL	STD. B ORF	STD. C LL	STD. C ORF	P411 LL	P411 ORF	P413 LL	P413 ORF
Lower Chord	L0-L1	104.6	674.8	1.15	90.9	2.38	3.96	87.3	4.12	104.0	3.46	115.3	3.12	129.4	2.78	143.5	2.51
	L1-L2	104.6	674.8	1.15	90.9	2.38	3.96	87.3	4.12	104.0	3.46	115.3	3.12	129.4	2.78	143.5	2.51
	L2-L3	-106.8	709.9	1.11	-167.5	1.42	2.36	-108.8	3.63	-130.6	3.02	-145.7	2.71	-170.7	2.31	-195.1	2.02
	L3-L4	-106.8	709.9	1.11	-167.5	1.42	2.36	-108.8	3.63	-130.6	3.02	-145.7	2.71	-170.7	2.31	-195.1	2.02
	L4-L5	-651.2	1518.8	1.11	-204.0	1.37	2.28	-132.6	3.51	-159.1	2.92	-177.5	2.62	-208.0	2.24	-237.7	1.96
	L5-L6	-651.2	1518.8	1.11	-204.0	1.37	2.28	-132.6	3.51	-159.1	2.92	-177.5	2.62	-208.0	2.24	-237.7	1.96
	L6-L7	-494.3	1106.1	1.11	-111.8	1.72	2.87	-79.3	4.04	-95.2	3.37	-105.9	3.03	-123.3	2.60	-140.8	2.28
	L7-L8	-494.3	1106.1	1.11	-111.8	1.72	2.87	-79.3	4.04	-95.2	3.37	-105.9	3.03	-123.3	2.60	-140.8	2.28
	L8-L9	521.5	1236.0	1.09	121.0	1.95	3.25	94.3	4.17	112.8	3.49	125.5	3.13	144.9	2.71	164.2	2.40
	L9-L10	521.5	1236.0	1.09	121.0	1.95	3.25	94.3	4.17	112.8	3.49	125.5	3.13	144.9	2.71	164.2	2.40
	L10-L11	1119.9	2750.5	1.09	259.4	2.11	3.52	199.4	4.57	239.1	3.81	265.8	3.43	302.4	3.02	343.1	2.66
	L11-L12	1119.9	2750.5	1.09	259.4	2.11	3.52	199.4	4.57	239.1	3.81	265.8	3.43	302.4	3.02	343.1	2.66
Upper Chord	U1-U2	-69.2	709.9	1.15	-145.5	1.71	2.85	-138.3	2.99	-165.1	2.51	-182.5	2.27	-201.6	2.05	-222.9	1.86
	U2-U3	-69.2	709.9	1.15	-145.5	1.71	2.85	-138.3	2.99	-165.1	2.51	-182.5	2.27	-201.6	2.05	-222.9	1.86
	U3-U4	366.8	1236.0	1.11	192.1	1.64	2.73	124.9	4.21	149.8	3.51	167.1	3.14	195.9	2.68	223.9	2.35
	U4-U5	336.8	1236.0	1.11	192.1	1.73	2.88	124.9	4.42	149.8	3.69	167.1	3.31	195.9	2.82	223.9	2.47
	U5-U6	1107.6	2524.6	1.11	244.8	1.84	3.07	159.1	4.72	191.0	3.93	213.0	3.52	249.6	3.01	285.3	2.63
	U6-U7	1107.6	2524.6	1.11	244.8	1.84	3.07	159.1	4.72	191.0	3.93	213.0	3.52	249.6	3.01	285.3	2.63
	U7-U8	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U8-U9	0.0	674.8	1.11	0.0			0.0		0.0		0.0		0.0		0.0	
	U9-U10	-894.6	1922.7	1.09	-207.5	1.55	2.58	-160.5	3.34	-192.3	2.78	-214.0	2.50	-245.9	2.18	-277.0	1.93
	U10-U11	-894.6	1922.7	1.09	-207.5	1.55	2.58	-160.5	3.34	-192.3	2.78	-214.0	2.50	-245.9	2.18	-277.0	1.93
	U11-U12	-1192.2	2533.1	1.09	-276.6	1.50	2.50	-211.4	3.28	-252.7	2.74	-280.7	2.47	-317.4	2.18	-360.5	1.92
Verticals	L1-U1	133.1	708.2	1.25	75.0	2.63	4.38	81.7	4.02	91.0	3.61	93.8	3.50	95.7	3.43	94.6	3.47
	L2-U2	-9.2	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L3-U3	134.5	1278.0	1.25	75.0	5.42	9.03	81.7	8.29	91.0	7.44	93.8	7.22	95.7	7.08	94.6	7.16
	L4-U4	-9.6	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L5-U5	139.8	708.2	1.25	75.0	2.59	4.31	81.7	3.96	91.0	3.55	93.8	3.45	95.7	3.38	94.6	3.42
	L6-U6	-16.1	314.2	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L7-U7	137.5	708.2	1.25	75.0	2.60	4.34	81.7	3.98	91.0	3.57	93.8	3.47	95.7	3.40	94.6	3.44
	L8-U8	-8.0	368.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L9-U9	134.5	708.2	1.25	75.0	2.62	4.37	81.7	4.01	91.0	3.60	93.8	3.49	95.7	3.42	94.6	3.46
	L10-U10	-13.5	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
	L11-U11	139.0	1278.0	1.25	75.0	5.39	8.98	81.7	8.25	91.0	7.41	93.8	7.18	95.7	7.04	94.6	7.12
	L12-U12	-9.7	435.3	1.25	0.0			0.0		0.0		0.0		0.0		0.0	
Diagonals	L0-U1	-152.1	910.1	1.15	-144.3	1.98	3.30	-127.1	3.74	-151.3	3.15	-167.7	2.84	-188.2	2.53	-208.7	2.28
	U1-L2	-51.5	579.0	1.30	-90.0	2.02	3.36	-52.8	5.73	-63.3	4.78	-70.6	4.29	-82.8	3.65	-94.6	3.20
	L2-U3	255.9	708.2	1.24	102.5	1.36	2.27	52.8	4.41	63.3	3.67	70.6	3.29	82.8	2.81	94.6	2.46
	U3-L4	-368.3	814.1	1.19	-110.6	1.17	1.96	-94.1	2.30	-110.6	1.96	-120.8	1.79	-126.0	1.72	-129.5	1.67
	L4-U5	511.6	1278.0	1.17	139.6	1.73	2.88	115.1	3.50	136.2	2.95	150.2	2.68	164.6	2.44	177.9	2.26
	U5-L6	-801.7	1731.0	1.15	-189.1	1.46	2.43	-112.2	4.10	-133.6	3.44	-148.1	3.11	-166.2	2.77	-184.3	2.50
	L6-U7	-1077.4	2394.7	1.10	-246.8	1.69	2.81	-147.5	4.71	-178.5	3.89	-199.8	3.47	-234.9	2.96	-271.1	2.56
	U7-L8	868.5	2061.8	1.11	209.4	1.85	3.08	139.5	4.63	167.3	3.86	186.2	3.47	216.7	2.98	247.5	2.61
	L8-U9	-758.3	1959.5	1.12	-189.0	2.12	3.53	-137.0	4.88	-164.0	4.07	-182.5	3.66	-210.7	3.17	-238.8	2.80
	U9-L10	542.6	1278.0	1.13	144.3	1.62	2.70	116.1	3.35	138.6	2.81	153.8	2.53	175.3	2.22	196.7	1.98
	L10-U11	-327.6	784.5	1.15	-104.9	1.37	2.28	-95.2	2.52	-113.3	2.12	-125.3	1.91	-140.0	1.71	-154.7	1.55
	U11-L12	105.1	708.2	1.17	72.0	3.13	5.21	74.3	5.05	87.8	4.28	96.6	3.89	104.7	3.58	112.6	3.33
					U3-L4	**1.17**	**1.96**	**U3-L4**	**2.30**	**U3-L4**	**1.96**	**U3-L4**	**1.79**	**L10-U11**	**1.71**	**L10-U11**	**1.55**

X.XX Indicates inventory rating factor < 0.9 or operating rating factor < 1.15

Truss Gusset Results – Analysis 2 – LFR Ratings for HS20 Live Load

Truss Joint Review Summary (LFR)

Bridge Number 9040

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.58	4.31	Shear controls	---	---	---	---
L1	4.36	7.29	Tension controls	U1	2.02	3.36	Bearing and shear on rivets controls
L2	1.33	2.23	Bearing and shear on rivets controls	U2	2.74	4.58	Bearing and shear on rivets controls
L3	5.23	8.73	Block shear controls	U3	0.93	1.56	Bearing and shear on rivets controls
L4	1.91	3.18	Bearing and shear on rivets controls	U4	---	---	N/A
L5	4.28	7.14	Bearing and shear on rivets controls	U5	1.08	1.80	Bearing and shear on rivets controls
L6	1.07	1.78	Bearing and shear on rivets controls	U6	---	---	N/A
L7	4.33	7.22	Tension controls	U7	1.70	2.83	Bearing and shear on rivets controls
L8	1.48	2.48	Shear controls	U8	---	---	N/A
L9	4.35	7.26	Tension controls	U9	1.60	2.66	Bearing and shear on rivets controls
L10	1.21	2.02	Block shear controls	U10	---	---	N/A
L11	5.19	8.66	Block shear controls	U11	1.07	1.78	Bearing and shear on rivets controls
L12	1.34	2.23	Flexure Controls	---	---	---	---

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for HL93 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** HL-93

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.98	2.57	Shear Controls	---	---	---	N/A
L1	3.77	4.88	Tension Controls	U1	1.79	2.32	Bearing and Shear in Rivets Controls
L2	1.17	1.51	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.50	5.83	Block Shear Controls	U3	1.02	1.32	Bearing and Shear in Rivets Controls
L4	1.03	1.33	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.70	4.79	Bearing and Shear in Rivets Controls	U5	1.15	1.48	Bearing and Shear in Rivets Controls
L6	1.42	1.84	Flexure Controls	U6	---	---	N/A
L7	3.74	4.84	Tension Controls	U7	1.51	1.96	Bearing and Shear in Rivets Controls
L8	1.50	1.95	Shear Controls	U8	---	---	N/A
L9	3.76	4.87	Tension Controls	U9	1.59	2.06	Bearing and Shear in Rivets Controls
L10	1.19	1.54	Block Shear Controls	U10	---	---	N/A
L11	4.46	5.79	Block Shear Controls	U11	1.07	1.39	Bearing and Shear in Rivets Controls
L12	1.27	1.64	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for STD. A Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** STD. A

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	3.27	4.23	Shear Controls	---	---	---	N/A
L1	4.85	6.29	Tension Controls	U1	2.30	2.98	Bearing and Shear in Rivets Controls
L2	2.37	3.07	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.79	7.51	Block Shear Controls	U3	2.17	2.82	Bearing and Shear in Rivets Controls
L4	2.19	2.84	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.77	6.18	Bearing and Shear in Rivets Controls	U5	2.24	2.91	Bearing and Shear in Rivets Controls
L6	3.06	3.96	Flexure Controls	U6	---	---	N/A
L7	4.81	6.24	Tension Controls	U7	2.26	2.93	Bearing and Shear in Rivets Controls
L8	3.01	3.90	Shear Controls	U8	---	---	N/A
L9	4.84	6.27	Tension Controls	U9	2.29	2.97	Bearing and Shear in Rivets Controls
L10	2.25	2.92	Block Shear Controls	U10	---	---	N/A
L11	5.75	7.46	Block Shear Controls	U11	2.04	2.64	Bearing and Shear in Rivets Controls
L12	2.29	2.97	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for STD. B Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** STD. B

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.74	3.55	Shear Controls	---	---	---	N/A
L1	4.36	5.65	Tension Controls	U1	2.07	2.68	Bearing and Shear in Rivets Controls
L2	1.99	2.58	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.20	6.74	Block Shear Controls	U3	1.81	2.35	Bearing and Shear in Rivets Controls
L4	1.83	2.36	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.28	5.55	Bearing and Shear in Rivets Controls	U5	2.01	2.61	Bearing and Shear in Rivets Controls
L6	2.55	3.31	Flexure Controls	U6	---	---	N/A
L7	4.32	5.60	Tension Controls	U7	2.03	2.63	Bearing and Shear in Rivets Controls
L8	2.51	3.25	Shear Controls	U8	---	---	N/A
L9	4.35	5.63	Tension Controls	U9	2.06	2.66	Bearing and Shear in Rivets Controls
L10	1.88	2.43	Block Shear Controls	U10	---	---	N/A
L11	5.17	6.70	Block Shear Controls	U11	1.71	2.21	Bearing and Shear in Rivets Controls
L12	1.92	2.49	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for STD. C Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** STD. C

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.47	3.20	Shear Controls	---	---	---	N/A
L1	4.23	5.48	Tension Controls	U1	2.01	2.60	Bearing and Shear in Rivets Controls
L2	1.79	2.33	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.05	6.54	Block Shear Controls	U3	1.62	2.11	Bearing and Shear in Rivets Controls
L4	1.64	2.12	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.15	5.38	Bearing and Shear in Rivets Controls	U5	1.82	2.37	Bearing and Shear in Rivets Controls
L6	2.29	2.97	Flexure Controls	U6	---	---	N/A
L7	4.19	5.44	Tension Controls	U7	1.97	2.56	Bearing and Shear in Rivets Controls
L8	2.26	2.92	Shear Controls	U8	---	---	N/A
L9	4.22	5.47	Tension Controls	U9	1.99	2.59	Bearing and Shear in Rivets Controls
L10	1.69	2.19	Block Shear Controls	U10	---	---	N/A
L11	5.01	6.50	Block Shear Controls	U11	1.54	1.99	Bearing and Shear in Rivets Controls
L12	1.73	2.24	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for P411 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** P411

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.20	2.86	Shear Controls	---	---	---	N/A
L1	4.14	5.37	Tension Controls	U1	1.97	2.55	Bearing and Shear in Rivets Controls
L2	1.59	2.06	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.95	6.41	Block Shear Controls	U3	1.39	1.80	Bearing and Shear in Rivets Controls
L4	1.40	1.81	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.07	5.27	Bearing and Shear in Rivets Controls	U5	1.56	2.02	Bearing and Shear in Rivets Controls
L6	1.98	2.57	Flexure Controls	U6	---	---	N/A
L7	4.11	5.33	Tension Controls	U7	1.93	2.51	Bearing and Shear in Rivets Controls
L8	1.94	2.51	Shear Controls	U8	---	---	N/A
L9	4.13	5.36	Tension Controls	U9	1.91	2.47	Shear Controls
L10	1.48	1.92	Block Shear Controls	U10	---	---	N/A
L11	4.91	6.37	Block Shear Controls	U11	1.36	1.76	Bearing and Shear in Rivets Controls
L12	1.54	1.99	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 4 – LRFR Ratings for P413 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A4 **Live Load Case** P413

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.99	2.57	Shear Controls	---	---	---	N/A
L1	4.19	5.43	Tension Controls	U1	1.88	2.44	Bearing and Shear in Rivets Controls
L2	1.39	1.80	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.00	6.49	Block Shear Controls	U3	1.21	1.57	Bearing and Shear in Rivets Controls
L4	1.23	1.58	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.12	5.34	Bearing and Shear in Rivets Controls	U5	1.36	1.77	Bearing and Shear in Rivets Controls
L6	1.75	2.27	Flexure Controls	U6	---	---	N/A
L7	4.16	5.39	Tension Controls	U7	1.70	2.21	Bearing and Shear in Rivets Controls
L8	1.70	2.20	Shear Controls	U8	---	---	N/A
L9	4.18	5.42	Tension Controls	U9	1.69	2.19	Shear Controls
L10	1.31	1.70	Block Shear Controls	U10	---	---	N/A
L11	4.97	6.44	Block Shear Controls	U11	1.19	1.55	Bearing and Shear in Rivets Controls
L12	1.37	1.77	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for HL93 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** HL-93

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.08	2.69	Shear Controls	---	---	---	N/A
L1	3.93	5.10	Tension Controls	U1	1.89	2.44	Bearing and Shear in Rivets Controls
L2	1.20	1.56	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.66	6.04	Block Shear Controls	U3	1.16	1.51	Bearing and Shear in Rivets Controls
L4	1.28	1.65	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.86	5.01	Bearing and Shear in Rivets Controls	U5	1.50	1.95	Bearing and Shear in Rivets Controls
L6	1.70	2.21	Flexure Controls	U6	---	---	N/A
L7	3.90	5.06	Tension Controls	U7	1.85	2.40	Bearing and Shear in Rivets Controls
L8	1.84	2.39	Shear Controls	U8	---	---	N/A
L9	3.92	5.08	Tension Controls	U9	1.91	2.48	Shear Controls
L10	1.51	1.96	Block Shear Controls	U10	---	---	N/A
L11	4.63	6.00	Block Shear Controls	U11	1.40	1.81	Bearing and Shear in Rivets Controls
L12	1.56	2.02	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for STD. A Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** STD. A

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	3.42	4.44	Shear Controls	---	---	---	N/A
L1	5.07	6.57	Tension Controls	U1	2.51	3.26	Bearing and Shear in Rivets Controls
L2	2.53	3.27	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	6.01	7.79	Block Shear Controls	U3	2.48	3.21	Bearing and Shear in Rivets Controls
L4	2.72	3.52	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.98	6.45	Bearing and Shear in Rivets Controls	U5	2.46	3.18	Bearing and Shear in Rivets Controls
L6	3.67	4.76	Flexure Controls	U6	---	---	N/A
L7	5.03	6.52	Tension Controls	U7	2.48	3.21	Bearing and Shear in Rivets Controls
L8	3.70	4.79	Shear Controls	U8	---	---	N/A
L9	5.05	6.55	Tension Controls	U9	2.50	3.24	Bearing and Shear in Rivets Controls
L10	2.80	3.62	Bearing and Shear in Rivets Controls	U10	---	---	N/A
L11	5.97	7.73	Block Shear Controls	U11	2.67	3.46	Bearing and Shear in Rivets Controls
L12	2.82	3.66	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for STD. B Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** STD. B

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.87	3.72	Shear Controls	---	---	---	N/A
L1	4.55	5.90	Tension Controls	U1	2.26	2.93	Bearing and Shear in Rivets Controls
L2	2.12	2.75	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.39	6.99	Block Shear Controls	U3	2.07	2.68	Bearing and Shear in Rivets Controls
L4	2.27	2.94	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.47	5.79	Bearing and Shear in Rivets Controls	U5	2.21	2.86	Bearing and Shear in Rivets Controls
L6	3.07	3.98	Flexure Controls	U6	---	---	N/A
L7	4.51	5.85	Tension Controls	U7	2.22	2.88	Bearing and Shear in Rivets Controls
L8	3.08	3.99	Shear Controls	U8	---	---	N/A
L9	4.54	5.88	Tension Controls	U9	2.25	2.91	Bearing and Shear in Rivets Controls
L10	2.35	3.04	Bearing and Shear in Rivets Controls	U10	---	---	N/A
L11	5.36	6.94	Block Shear Controls	U11	2.23	2.89	Bearing and Shear in Rivets Controls
L12	2.36	3.06	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for STD. C Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** STD. C

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.59	3.36	Shear Controls	---	---	---	N/A
L1	4.41	5.72	Tension Controls	U1	2.19	2.84	Bearing and Shear in Rivets Controls
L2	1.91	2.48	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.23	6.78	Block Shear Controls	U3	1.85	2.40	Bearing and Shear in Rivets Controls
L4	2.04	2.63	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.34	5.62	Bearing and Shear in Rivets Controls	U5	2.14	2.77	Bearing and Shear in Rivets Controls
L6	2.76	3.57	Flexure Controls	U6	---	---	N/A
L7	4.38	5.68	Tension Controls	U7	2.16	2.80	Bearing and Shear in Rivets Controls
L8	2.77	3.59	Shear Controls	U8	---	---	N/A
L9	4.40	5.71	Tension Controls	U9	2.18	2.83	Bearing and Shear in Rivets Controls
L10	2.12	2.75	Bearing and Shear in Rivets Controls	U10	---	---	N/A
L11	5.20	6.74	Block Shear Controls	U11	2.01	2.60	Bearing and Shear in Rivets Controls
L12	2.13	2.76	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for P411 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** P411

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.31	2.99	Shear Controls	---	---	---	N/A
L1	4.32	5.61	Tension Controls	U1	2.14	2.77	Bearing and Shear in Rivets Controls
L2	1.64	2.12	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.13	6.65	Block Shear Controls	U3	1.58	2.05	Bearing and Shear in Rivets Controls
L4	1.74	2.25	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.25	5.51	Bearing and Shear in Rivets Controls	U5	2.04	2.65	Bearing and Shear in Rivets Controls
L6	2.38	3.09	Flexure Controls	U6	---	---	N/A
L7	4.29	5.56	Tension Controls	U7	2.11	2.74	Bearing and Shear in Rivets Controls
L8	2.38	3.08	Shear Controls	U8	---	---	N/A
L9	4.31	5.59	Tension Controls	U9	2.14	2.77	Bearing and Shear in Rivets Controls
L10	1.89	2.45	Block Shear Controls	U10	---	---	N/A
L11	5.09	6.60	Block Shear Controls	U11	1.78	2.30	Bearing and Shear in Rivets Controls
L12	1.89	2.45	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 5 – LRFR Ratings for P413 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A5 **Live Load Case** P413

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.08	2.70	Shear Controls	---	---	---	N/A
L1	4.37	5.67	Tension Controls	U1	1.93	2.50	Bearing and Shear in Rivets Controls
L2	1.43	1.86	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.19	6.72	Block Shear Controls	U3	1.38	1.79	Bearing and Shear in Rivets Controls
L4	1.52	1.97	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.30	5.57	Bearing and Shear in Rivets Controls	U5	1.79	2.31	Bearing and Shear in Rivets Controls
L6	2.11	2.73	Flexure Controls	U6	---	---	N/A
L7	4.34	5.63	Tension Controls	U7	2.09	2.71	Bearing and Shear in Rivets Controls
L8	2.08	2.70	Shear Controls	U8	---	---	N/A
L9	4.36	5.66	Tension Controls	U9	2.02	2.62	Shear Controls
L10	1.67	2.16	Block Shear Controls	U10	---	---	N/A
L11	5.15	6.68	Block Shear Controls	U11	1.56	2.02	Bearing and Shear in Rivets Controls
L12	1.68	2.18	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for HL93 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** HL-93

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.84	2.39	Shear Controls	---	---	---	N/A
L1	3.52	4.56	Tension Controls	U1	1.54	2.00	Bearing and Shear in Rivets Controls
L2	1.12	1.45	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.25	5.51	Block Shear Controls	U3	0.81	1.05	Bearing and Shear in Rivets Controls
L4	0.66	0.85	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.45	4.48	Bearing and Shear in Rivets Controls	U5	0.62	0.80	Bearing and Shear in Rivets Controls
L6	1.00	1.29	Flexure Controls	U6	---	---	N/A
L7	3.49	4.53	Tension Controls	U7	1.01	1.30	Bearing and Shear in Rivets Controls
L8	1.00	1.29	Shear Controls	U8	---	---	N/A
L9	3.51	4.55	Tension Controls	U9	1.11	1.43	Bearing and Shear in Rivets Controls
L10	0.70	0.91	Block Shear Controls	U10	---	---	N/A
L11	4.22	5.47	Block Shear Controls	U11	0.59	0.76	Bearing and Shear in Rivets Controls
L12	0.84	1.09	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for STD. A Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** STD. A

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	3.03	3.93	Shear Controls	---	---	---	N/A
L1	4.54	5.88	Tension Controls	U1	1.99	2.58	Bearing and Shear in Rivets Controls
L2	2.14	2.77	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.48	7.10	Block Shear Controls	U3	1.73	2.24	Bearing and Shear in Rivets Controls
L4	1.41	1.82	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.45	5.77	Bearing and Shear in Rivets Controls	U5	1.32	1.72	Bearing and Shear in Rivets Controls
L6	2.15	2.79	Flexure Controls	U6	---	---	N/A
L7	4.50	5.83	Tension Controls	U7	1.95	2.53	Bearing and Shear in Rivets Controls
L8	2.00	2.59	Shear Controls	U8	---	---	N/A
L9	4.53	5.87	Tension Controls	U9	1.97	2.56	Bearing and Shear in Rivets Controls
L10	1.33	1.73	Block Shear Controls	U10	---	---	N/A
L11	5.44	7.05	Block Shear Controls	U11	1.12	1.45	Bearing and Shear in Rivets Controls
L12	1.52	1.97	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for STD. B Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** STD. B

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.54	3.30	Shear Controls	---	---	---	N/A
L1	4.07	5.28	Tension Controls	U1	1.78	2.31	Bearing and Shear in Rivets Controls
L2	1.79	2.32	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.92	6.38	Block Shear Controls	U3	1.44	1.87	Bearing and Shear in Rivets Controls
L4	1.18	1.52	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.00	5.18	Bearing and Shear in Rivets Controls	U5	1.10	1.43	Bearing and Shear in Rivets Controls
L6	1.80	2.33	Flexure Controls	U6	---	---	N/A
L7	4.04	5.24	Tension Controls	U7	1.68	2.18	Bearing and Shear in Rivets Controls
L8	1.67	2.16	Shear Controls	U8	---	---	N/A
L9	4.06	5.27	Tension Controls	U9	1.73	2.24	Shear Controls
L10	1.11	1.44	Block Shear Controls	U10	---	---	N/A
L11	4.88	6.33	Block Shear Controls	U11	0.94	1.21	Bearing and Shear in Rivets Controls
L12	1.27	1.65	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for STD. C Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** STD. C

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.30	2.98	Shear Controls	---	---	---	N/A
L1	3.95	5.12	Tension Controls	U1	1.73	2.24	Bearing and Shear in Rivets Controls
L2	1.62	2.10	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.77	6.19	Block Shear Controls	U3	1.29	1.67	Bearing and Shear in Rivets Controls
L4	1.05	1.36	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.88	5.03	Bearing and Shear in Rivets Controls	U5	0.99	1.28	Bearing and Shear in Rivets Controls
L6	1.61	2.09	Flexure Controls	U6	---	---	N/A
L7	3.92	5.08	Tension Controls	U7	1.51	1.96	Bearing and Shear in Rivets Controls
L8	1.50	1.94	Shear Controls	U8	---	---	N/A
L9	3.94	5.11	Tension Controls	U9	1.56	2.02	Shear Controls
L10	1.00	1.30	Block Shear Controls	U10	---	---	N/A
L11	4.74	6.14	Block Shear Controls	U11	0.84	1.09	Bearing and Shear in Rivets Controls
L12	1.14	1.48	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for P411 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** P411

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.04	2.65	Shear Controls	---	---	---	N/A
L1	3.87	5.02	Tension Controls	U1	1.70	2.20	Bearing and Shear in Rivets Controls
L2	1.44	1.87	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.68	6.06	Block Shear Controls	U3	1.10	1.43	Bearing and Shear in Rivets Controls
L4	0.90	1.16	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.80	4.93	Bearing and Shear in Rivets Controls	U5	0.84	1.09	Bearing and Shear in Rivets Controls
L6	1.40	1.81	Flexure Controls	U6	---	---	N/A
L7	3.84	4.98	Tension Controls	U7	1.30	1.68	Bearing and Shear in Rivets Controls
L8	1.29	1.67	Shear Controls	U8	---	---	N/A
L9	3.86	5.01	Tension Controls	U9	1.35	1.75	Bearing and Shear in Rivets Controls
L10	0.88	1.14	Block Shear Controls	U10	---	---	N/A
L11	4.64	6.02	Block Shear Controls	U11	0.75	0.97	Bearing and Shear in Rivets Controls
L12	1.02	1.32	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 10 – LRFR Ratings for P413 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A10 **Live Load Case** P413

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.84	2.39	Shear Controls	---	---	---	N/A
L1	3.92	5.08	Tension Controls	U1	1.72	2.22	Bearing and Shear in Rivets Controls
L2	1.30	1.68	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.73	6.13	Block Shear Controls	U3	0.96	1.25	Bearing and Shear in Rivets Controls
L4	0.79	1.02	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.84	4.98	Bearing and Shear in Rivets Controls	U5	0.74	0.96	Bearing and Shear in Rivets Controls
L6	1.23	1.60	Flexure Controls	U6	---	---	N/A
L7	3.89	5.04	Tension Controls	U7	1.14	1.47	Bearing and Shear in Rivets Controls
L8	1.13	1.46	Shear Controls	U8	---	---	N/A
L9	3.91	5.07	Tension Controls	U9	1.19	1.55	Bearing and Shear in Rivets Controls
L10	0.78	1.01	Block Shear Controls	U10	---	---	N/A
L11	4.70	6.09	Block Shear Controls	U11	0.66	0.85	Bearing and Shear in Rivets Controls
L12	0.90	1.17	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12 – LRFR Ratings for HL93 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** HL-93

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.94	2.51	Shear Controls	---	---	---	N/A
L1	3.69	4.78	Tension Controls	U1	1.71	2.21	Bearing and Shear in Rivets Controls
L2	1.15	1.49	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.42	5.72	Block Shear Controls	U3	0.95	1.23	Bearing and Shear in Rivets Controls
L4	0.91	1.18	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.62	4.69	Bearing and Shear in Rivets Controls	U5	0.98	1.26	Bearing and Shear in Rivets Controls
L6	1.28	1.66	Flexure Controls	U6	---	---	N/A
L7	3.66	4.74	Tension Controls	U7	1.35	1.74	Bearing and Shear in Rivets Controls
L8	1.34	1.74	Shear Controls	U8	---	---	N/A
L9	3.68	4.77	Tension Controls	U9	1.43	1.85	Bearing and Shear in Rivets Controls
L10	1.03	1.34	Block Shear Controls	U10	---	---	N/A
L11	4.39	5.69	Block Shear Controls	U11	0.91	1.19	Bearing and Shear in Rivets Controls
L12	1.13	1.46	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12– LRFR Ratings for STD. A Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** STD. A

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	3.19	4.13	Shear Controls	---	---	---	N/A
L1	4.75	6.16	Tension Controls	U1	2.20	2.85	Bearing and Shear in Rivets Controls
L2	2.29	2.97	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.69	7.38	Block Shear Controls	U3	2.03	2.63	Bearing and Shear in Rivets Controls
L4	1.94	2.51	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.66	6.04	Bearing and Shear in Rivets Controls	U5	2.08	2.70	Bearing and Shear in Rivets Controls
L6	2.76	3.58	Flexure Controls	U6	---	---	N/A
L7	4.71	6.11	Tension Controls	U7	2.16	2.80	Bearing and Shear in Rivets Controls
L8	2.68	3.48	Shear Controls	U8	---	---	N/A
L9	4.74	6.14	Tension Controls	U9	2.19	2.84	Bearing and Shear in Rivets Controls
L10	1.95	2.53	Block Shear Controls	U10	---	---	N/A
L11	5.65	7.33	Block Shear Controls	U11	1.74	2.26	Bearing and Shear in Rivets Controls
L12	2.04	2.65	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12 – LRFR Ratings for STD. B Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** STD. B

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.68	3.47	Shear Controls	---	---	---	N/A
L1	4.27	5.53	Tension Controls	U1	1.97	2.56	Bearing and Shear in Rivets Controls
L2	1.92	2.50	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	5.11	6.62	Block Shear Controls	U3	1.69	2.19	Bearing and Shear in Rivets Controls
L4	1.62	2.09	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.19	5.43	Bearing and Shear in Rivets Controls	U5	1.73	2.25	Bearing and Shear in Rivets Controls
L6	2.31	2.99	Flexure Controls	U6	---	---	N/A
L7	4.23	5.48	Tension Controls	U7	1.94	2.52	Bearing and Shear in Rivets Controls
L8	2.24	2.90	Shear Controls	U8	---	---	N/A
L9	4.25	5.51	Tension Controls	U9	1.96	2.55	Bearing and Shear in Rivets Controls
L10	1.63	2.11	Block Shear Controls	U10	---	---	N/A
L11	5.07	6.58	Block Shear Controls	U11	1.46	1.89	Bearing and Shear in Rivets Controls
L12	1.71	2.22	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12 – LRFR Ratings for STD. C Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** STD. C

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.41	3.13	Shear Controls	---	---	---	N/A
L1	4.14	5.36	Tension Controls	U1	1.92	2.48	Bearing and Shear in Rivets Controls
L2	1.74	2.25	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.96	6.43	Block Shear Controls	U3	1.52	1.97	Bearing and Shear in Rivets Controls
L4	1.45	1.87	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.06	5.27	Bearing and Shear in Rivets Controls	U5	1.55	2.01	Bearing and Shear in Rivets Controls
L6	2.07	2.69	Flexure Controls	U6	---	---	N/A
L7	4.10	5.32	Tension Controls	U7	1.88	2.44	Bearing and Shear in Rivets Controls
L8	2.01	2.61	Shear Controls	U8	---	---	N/A
L9	4.13	5.35	Tension Controls	U9	1.91	2.47	Bearing and Shear in Rivets Controls
L10	1.47	1.90	Block Shear Controls	U10	---	---	N/A
L11	4.92	6.38	Block Shear Controls	U11	1.31	1.70	Bearing and Shear in Rivets Controls
L12	1.54	2.00	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12 – LRFR Ratings for P411 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** P411

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	2.15	2.79	Shear Controls	---	---	---	N/A
L1	4.06	5.26	Tension Controls	U1	1.88	2.43	Bearing and Shear in Rivets Controls
L2	1.55	2.01	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.86	6.30	Block Shear Controls	U3	1.29	1.68	Bearing and Shear in Rivets Controls
L4	1.24	1.60	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	3.98	5.16	Bearing and Shear in Rivets Controls	U5	1.33	1.72	Bearing and Shear in Rivets Controls
L6	1.79	2.33	Flexure Controls	U6	---	---	N/A
L7	4.02	5.22	Tension Controls	U7	1.74	2.25	Bearing and Shear in Rivets Controls
L8	1.73	2.24	Shear Controls	U8	---	---	N/A
L9	4.05	5.24	Tension Controls	U9	1.73	2.24	Shear Controls
L10	1.29	1.67	Block Shear Controls	U10	---	---	N/A
L11	4.82	6.25	Block Shear Controls	U11	1.16	1.50	Bearing and Shear in Rivets Controls
L12	1.37	1.77	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Truss Gusset Results – Analysis 12 – LRFR Ratings for P413 Live Load

Truss Joint Review Summary (LRFR)

Bridge Number 9040

Dead Load Case A12 **Live Load Case** P413

LOWER JOINTS				UPPER JOINTS			
Joint	RF_{inv}	RF_{op}	Comments*	Joint	RF_{inv}	RF_{op}	Comments*
L0	1.94	2.51	Shear Controls	---	---	---	N/A
L1	4.10	5.32	Tension Controls	U1	1.86	2.41	Bearing and Shear in Rivets Controls
L2	1.37	1.78	Bearing and Shear in Rivets Controls	U2	---	---	N/A
L3	4.91	6.37	Block Shear Controls	U3	1.13	1.47	Bearing and Shear in Rivets Controls
L4	1.08	1.40	Bearing and Shear in Rivets Controls	U4	---	---	N/A
L5	4.03	5.22	Bearing and Shear in Rivets Controls	U5	1.16	1.50	Bearing and Shear in Rivets Controls
L6	1.58	2.05	Flexure Controls	U6	---	---	N/A
L7	4.07	5.28	Tension Controls	U7	1.52	1.97	Bearing and Shear in Rivets Controls
L8	1.51	1.96	Shear Controls	U8	---	---	N/A
L9	4.09	5.30	Tension Controls	U9	1.53	1.98	Shear Controls
L10	1.14	1.47	Block Shear Controls	U10	---	---	N/A
L11	4.88	6.33	Block Shear Controls	U11	1.02	1.32	Bearing and Shear in Rivets Controls
L12	1.22	1.58	Flexure Controls	---	---	---	N/A

NOTE: Highlighted rating factors indicate a inventory rating factor < 0.90 or operating factor < 1.15

* Controlling mode based on inventory rating

Approach Results – Hangers Eliminated – Exterior Girder – Sheet 1 of 3

				STRENGTH I		
Span	Point	x (ft)	x_c (ft)	IRF	ORF	
1	1	0.000	0.000	0.13	0.16	< Shear
	2	6.205	6.205	2.45	3.18	
	3	12.410	12.410	2.32	3.06	
	4	18.615	18.615	1.40	1.86	
	5	19.500	19.500	1.32	1.76	
	6	24.820	24.820	1.98	2.61	
	7	25.000	25.000	1.98	2.61	
	8	31.025	31.025	1.62	2.14	
	9	37.230	37.230	1.41	1.87	
	10	43.435	43.435	1.28	1.71	
	11	49.640	49.640	1.25	1.66	
	12	50.000	50.000	1.24	1.65	
	13	55.845	55.845	1.26	1.68	
	14	62.050	62.050	1.32	1.75	
	15	68.255	68.255	1.46	1.94	
	16	74.460	74.460	1.66	2.20	
	17	75.000	75.000	1.68	2.22	
	18	80.665	80.665	2.00	2.64	
	19	86.870	86.870	2.49	3.28	
	20	88.500	88.500	1.62	2.15	
	21	93.075	93.075	1.69	2.25	
	22	97.000	97.000	1.45	1.93	
	23	99.280	99.280	1.32	1.76	
	24	100.000	100.000	1.28	1.70	
	25	103.000	103.000	0.99	1.33	
	26	105.485	105.485	0.84	1.14	
	27	110.100	110.100	0.54	0.76	
	28	111.690	111.690	1.05	1.41	
	29	117.100	117.100	0.75	1.03	
	30	117.895	117.895	1.22	1.64	
	31	124.100	124.100	0.70	0.96	

Ratings controlled by Flexure unless noted.

Approach Results – Hangers Eliminated – Exterior Girder – Sheet 2 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF
	2	1	0.000	124.100	0.70	0.96
		2	6.000	130.100	0.49	0.70
		3	7.505	131.605	0.61	0.85
		4	11.000	135.100	0.29	0.44
		5	15.010	139.110	0.58	0.81
		6	19.020	143.120	0.89	1.21
		7	22.020	146.120	1.14	1.52
		8	22.515	146.615	1.53	2.03
		9	25.020	149.120	1.75	2.32
		10	30.020	154.120	2.17	2.86
		11	37.525	161.625	1.81	2.39
		12	41.310	165.410	1.47	1.95
		13	43.236	167.336	1.93	2.55
		14	45.030	169.130	1.80	2.39
		15	50.310	174.410	1.50	1.99
		16	52.535	176.635	1.89	2.50
		17	60.040	184.140	1.62	2.15
		18	64.452	188.552	1.52	2.02
		19	67.545	191.645	1.49	1.98
		20	75.050	199.150	1.44	1.91
		21	82.555	206.655	1.45	1.93
		22	85.668	209.768	1.50	1.99
		23	90.060	214.160	1.58	2.09
		24	97.565	221.665	1.81	2.39
		25	99.810	223.910	1.42	1.89
		26	105.070	229.170	1.67	2.21
		27	106.884	230.984	1.78	2.36
		28	108.810	232.910	1.33	1.77
		29	112.575	236.675	1.60	2.13
		30	120.080	244.180	1.96	2.58
		31	125.080	249.180	1.59	2.11
		32	127.585	251.685	1.40	1.86
		33	128.080	252.180	1.36	1.81
		34	128.100	252.200	1.03	1.38
		35	131.080	255.180	0.82	1.11
		36	135.090	259.190	0.54	0.75
		37	139.120	263.220	0.28	0.42
		38	142.595	266.695	0.58	0.82
		39	144.120	268.220	0.47	0.68
		40	150.100	274.200	0.73	1.01

Ratings controlled by Flexure unless noted.

Approach Results – Hangers Eliminated – Exterior Girder – Sheet 3 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF
	3	1	0.000	274.200	0.73	1.01
		2	7.000	281.200	0.81	1.11
		3	7.505	281.705	0.85	1.16
		4	14.000	288.200	0.71	0.97
		5	15.010	289.210	0.78	1.06
		6	22.063	296.263	1.28	1.71
		7	22.515	296.715	1.31	1.75
		8	25.050	299.250	1.50	1.99
		9	25.063	299.263	1.55	2.06
		10	28.063	302.263	1.76	2.33
		11	30.020	304.220	1.88	2.48
		12	33.810	308.010	1.83	2.41
		13	37.525	311.725	2.26	2.98
		14	44.810	319.010	1.69	2.23
		15	45.030	319.230	2.31	3.05
		16	50.050	324.250	2.02	2.66
		17	52.535	326.735	1.91	2.52
		18	60.040	334.240	1.66	2.20
		19	67.545	341.745	1.53	2.03
		20	75.050	349.250	1.50	1.99 CL of Unit

Ratings controlled by Flexure unless noted.

Approach Results – Hangers Eliminated – Interior Girder – Sheet 1 of 3

				STRENGTH I		
Span	Point	x (ft)	x_c (ft)	IRF	ORF	
1	1	0.000	0.000	0.25	0.32	< Shear
	2	6.205	6.205	2.13	2.76	
	3	12.410	12.410	2.08	2.70	
	4	16.000	16.000	1.58	2.04	
	5	18.615	18.615	2.12	2.75	
	6	24.500	24.500	1.64	2.12	
	7	24.820	24.820	2.21	2.87	
	8	25.000	25.000	2.21	2.86	
	9	31.025	31.025	1.87	2.42	
	10	37.230	37.230	1.66	2.16	
	11	43.435	43.435	1.54	1.99	
	12	49.640	49.640	1.49	1.93	
	13	50.000	50.000	1.49	1.93	
	14	55.845	55.845	1.49	1.94	
	15	62.050	62.050	1.56	2.02	
	16	68.255	68.255	1.66	2.16	
	17	74.460	74.460	1.84	2.39	
	18	75.000	75.000	1.87	2.42	
	19	80.665	80.665	2.13	2.76	
	20	85.500	85.500	2.37	3.07	
	21	86.870	86.870	1.97	2.56	
	22	93.075	93.075	2.55	3.31	
	23	94.000	94.000	2.10	2.72	
	24	97.000	97.000	1.34	1.74	
	25	99.280	99.280	1.23	1.60	
	26	100.000	100.000	1.20	1.56	
	27	103.000	103.000	1.02	1.32	
	28	105.100	105.100	0.92	1.20	
	29	105.485	105.485	1.61	2.08	
	30	111.690	111.690	1.24	1.61	
	31	114.100	114.100	1.11	1.44	
	32	117.895	117.895	1.43	1.85	
	33	124.100	124.100	0.98	1.27	

Ratings controlled by Flexure unless noted.

Approach Results – Hangers Eliminated – Interior Girder – Sheet 2 of 3

				STRENGTH I	
Span	Point	x (ft)	x_c (ft)	IRF	ORF
2	1	0.000	124.100	0.98	1.27
	2	7.000	131.100	1.56	2.03
	3	7.505	131.605	1.06	1.38
	4	13.000	137.100	1.57	2.04
	5	15.010	139.110	0.90	1.17
	6	19.020	143.120	1.17	1.51
	7	22.020	146.120	1.38	1.79
	8	22.515	146.615	1.41	1.83
	9	25.020	149.120	1.58	2.04
	10	30.020	154.120	1.91	2.48
	11	37.525	161.625	1.76	2.28
	12	38.190	162.290	1.70	2.20
	13	43.236	167.336	2.00	2.59
	14	45.030	169.130	1.89	2.45
	15	48.190	172.290	1.72	2.22
	16	52.535	176.635	2.02	2.62
	17	60.040	184.140	1.77	2.30
	18	64.452	188.552	1.68	2.18
	19	67.545	191.645	1.64	2.13
	20	75.050	199.150	1.60	2.07
	21	82.555	206.655	1.62	2.10
	22	85.668	209.768	1.67	2.16
	23	90.060	214.160	1.74	2.25
	24	97.565	221.665	1.96	2.54
	25	101.940	226.040	2.16	2.80
	26	105.070	229.170	1.81	2.34
	27	106.884	230.984	1.93	2.50
	28	111.940	236.040	2.31	3.00
	29	112.575	236.675	1.65	2.14
	30	120.080	244.180	1.74	2.26
	31	125.080	249.180	1.45	1.88
	32	127.585	251.685	1.30	1.69
	33	128.080	252.180	1.16	1.51
	34	128.100	252.200	1.16	1.51
	35	128.110	252.210	1.16	1.51
	36	131.080	255.180	1.06	1.37
	37	135.090	259.190	0.82	1.07
	38	137.130	261.230	0.71	0.91
	39	142.595	266.695	1.00	1.30
	40	143.130	267.230	0.97	1.25
	41	150.100	274.200	1.01	1.31

Ratings controlled by Flexure unless noted.

Approach Results – Hangers Eliminated – Interior Girder – Sheet 3 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF	
		1	0.000	274.200	1.01	1.31	
		2	7.505	281.705	1.53	1.98	
		3	10.000	284.200	1.58	2.05	
		4	15.010	289.210	1.45	1.89	
		5	19.000	293.200	1.71	2.21	
		6	22.040	296.240	1.20	1.55	
		7	22.063	296.263	1.71	2.21	
		8	22.515	296.715	1.74	2.25	
		9	25.050	299.250	1.88	2.43	
		10	25.063	299.263	1.88	2.43	
	3	11	28.063	302.263	1.91	2.47	
		12	30.020	304.220	1.97	2.55	
		13	36.630	310.830	2.10	2.72	
		14	37.525	311.725	2.22	2.88	
		15	45.030	319.230	2.10	2.73	
		16	46.130	320.330	2.05	2.66	
		17	50.050	324.250	2.30	2.98	
		18	52.535	326.735	2.20	2.85	
		19	60.040	334.240	1.97	2.55	
		20	67.545	341.745	1.86	2.41	
		21	75.050	349.250	1.81	2.35	CL of Unit

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Exterior Girder – Sheet 1 of 3

				STRENGTH I		
Span	Point	x (ft)	x_c (ft)	IRF	ORF	
1	1	0.000	0.000	0.14	0.18	< Shear
	2	6.205	6.205	2.47	3.21	
	3	12.410	12.410	2.34	3.08	
	4	18.615	18.615	1.43	1.90	
	5	19.500	19.500	1.35	1.80	
	6	24.820	24.820	2.02	2.66	
	7	25.000	25.000	1.99	2.63	
	8	31.025	31.025	1.66	2.19	
	9	37.230	37.230	1.44	1.91	
	10	43.435	43.435	1.32	1.76	
	11	49.640	49.640	1.29	1.71	
	12	50.000	50.000	1.29	1.72	
	13	55.845	55.845	1.31	1.74	
	14	62.050	62.050	1.38	1.83	
	15	68.255	68.255	1.51	2.00	
	16	74.460	74.460	1.74	2.31	
	17	75.000	75.000	1.77	2.35	
	18	80.665	80.665	2.09	2.76	
	19	86.870	86.870	2.62	3.44	
	20	88.500	88.500	1.73	2.30	
	21	93.075	93.075	1.53	2.03	
	22	97.000	97.000	1.30	1.73	
	23	99.280	99.280	1.16	1.56	
	24	100.000	100.000	1.13	1.51	
	25	103.000	103.000	1.93	2.56	
	26	105.485	105.485	1.74	2.30	
	27	110.100	110.100	1.38	1.85	
	28	111.690	111.690	1.81	2.40	
	29	117.100	117.100	1.37	1.83	
	30	117.895	117.895	1.78	2.33	
	31	124.100	124.100	1.16	1.57	

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Exterior Girder – Sheet 2 of 3

				STRENGTH I	
Span	Point	x (ft)	x_c (ft)	IRF	ORF
2	1	0.000	124.100	1.16	1.57
	2	6.000	130.100	1.09	1.48
	3	7.505	131.605	1.30	1.74
	4	11.000	135.100	1.06	1.44
	5	15.010	139.110	1.44	1.92
	6	19.020	143.120	1.81	2.40
	7	22.020	146.120	1.01	1.36
	8	22.515	146.615	1.29	1.72
	9	25.020	149.120	1.50	2.00
	10	30.020	154.120	1.91	2.52
	11	37.525	161.625	2.03	2.67
	12	41.310	165.410	1.65	2.19
	13	43.236	167.336	2.13	2.80
	14	45.030	169.130	1.99	2.62
	15	50.310	174.410	1.65	2.18
	16	52.535	176.635	2.05	2.71
	17	60.040	184.140	1.76	2.33
	18	64.452	188.552	1.66	2.20
	19	67.545	191.645	1.61	2.14
	20	75.050	199.150	1.56	2.07
	21	82.555	206.655	1.58	2.10
	22	85.668	209.768	1.62	2.15
	23	90.060	214.160	1.71	2.26
	24	97.565	221.665	1.96	2.59
	25	99.810	223.910	1.56	2.07
	26	105.070	229.170	1.83	2.42
	27	106.884	230.984	1.95	2.58
	28	108.810	232.910	1.49	1.98
	29	112.575	236.675	1.80	2.39
	30	120.080	244.180	1.75	2.31
	31	125.080	249.180	1.38	1.84
	32	127.585	251.685	1.22	1.63
	33	128.080	252.180	1.17	1.57
	34	128.100	252.200	2.17	2.86
	35	131.080	255.180	1.90	2.52
	36	135.090	259.190	1.55	2.07
	37	139.120	263.220	1.21	1.63
	38	142.595	266.695	1.40	1.88
	39	144.120	268.220	1.25	1.68
	40	150.100	274.200	1.16	1.57

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Exterior Girder – Sheet 3 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF
	3	1	0.000	274.200	1.16	1.57
		2	7.000	281.200	1.36	1.82
		3	7.505	281.705	1.41	1.89
		4	14.000	288.200	1.41	1.88
		5	15.010	289.210	1.49	1.99
		6	22.063	296.263	2.07	2.73
		7	22.515	296.715	2.11	2.79
		8	25.050	299.250	2.31	3.00
		9	25.063	299.263	1.24	1.66
		10	28.063	302.263	1.43	1.90
		11	30.020	304.220	1.56	2.07
		12	33.810	308.010	1.98	2.62
		13	37.525	311.725	2.40	3.15
		14	44.810	319.010	1.80	2.39
		15	45.030	319.230	2.44	3.21
		16	50.050	324.250	2.12	2.80
		17	52.535	326.735	2.00	2.65
		18	60.040	334.240	1.75	2.32
		19	67.545	341.745	1.63	2.16
		20	75.050	349.250	1.59	2.12 CL of Unit
	MIN. OTHER THAN END PANEL SHEAR				1.01	1.36

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Interior Girder – Sheet 1 of 3

				STRENGTH I		
Span	Point	x (ft)	x_c (ft)	IRF	ORF	
1	1	0.000	0.000	0.25	0.33	< Shear
	2	6.205	6.205	2.14	2.77	
	3	12.410	12.410	2.09	2.71	
	4	16.000	16.000	1.67	2.16	
	5	18.615	18.615	2.10	2.72	
	6	24.500	24.500	1.63	2.11	
	7	24.820	24.820	2.21	2.87	
	8	25.000	25.000	2.21	2.87	
	9	31.025	31.025	1.87	2.43	
	10	37.230	37.230	1.67	2.17	
	11	43.435	43.435	1.54	2.00	
	12	49.640	49.640	1.50	1.94	
	13	50.000	50.000	1.50	1.94	
	14	55.845	55.845	1.52	1.97	
	15	62.050	62.050	1.57	2.03	
	16	68.255	68.255	1.69	2.19	
	17	74.460	74.460	1.87	2.43	
	18	75.000	75.000	1.90	2.47	
	19	80.665	80.665	2.17	2.82	
	20	85.500	85.500	2.34	3.04	
	21	86.870	86.870	2.02	2.62	
	22	93.075	93.075	2.03	2.64	
	23	94.000	94.000	1.99	2.58	
	24	97.000	97.000	1.25	1.62	
	25	99.280	99.280	1.16	1.50	
	26	100.000	100.000	1.12	1.46	
	27	103.000	103.000	1.64	2.12	
	28	105.100	105.100	1.52	1.97	
	29	105.485	105.485	1.83	2.38	
	30	111.690	111.690	1.67	2.16	
	31	114.100	114.100	1.56	2.03	
	32	117.895	117.895	1.55	2.01	
	33	124.100	124.100	1.33	1.72	

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Interior Girder – Sheet 2 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF
		1	0.000	124.100	1.33	1.72
		2	7.000	131.100	1.55	2.01
		3	7.505	131.605	1.29	1.67
		4	13.000	137.100	1.69	2.19
		5	15.010	139.110	1.33	1.73
		6	19.020	143.120	1.62	2.10
		7	22.020	146.120	1.86	2.41
		8	22.515	146.615	1.28	1.66
		9	25.020	149.120	1.44	1.87
		10	30.020	154.120	1.76	2.28
		11	37.525	161.625	1.86	2.41
		12	38.190	162.290	1.79	2.32
		13	43.236	167.336	2.09	2.71
		14	45.030	169.130	1.98	2.56
		15	48.190	172.290	1.79	2.32
		16	52.535	176.635	2.09	2.70
		17	60.040	184.140	1.82	2.37
		18	64.452	188.552	1.74	2.25
		19	67.545	191.645	1.69	2.19
		20	75.050	199.150	1.65	2.14
	2	21	82.555	206.655	1.68	2.17
		22	85.668	209.768	1.72	2.23
		23	90.060	214.160	1.79	2.32
		24	97.565	221.665	2.02	2.62
		25	101.940	226.040	2.22	2.88
		26	105.070	229.170	1.88	2.44
		27	106.884	230.984	1.99	2.57
		28	111.940	236.040	2.32	3.01
		29	112.575	236.675	1.73	2.25
		30	120.080	244.180	1.63	2.11
		31	125.080	249.180	1.34	1.73
		32	127.585	251.685	1.19	1.55
		33	128.080	252.180	1.17	1.52
		34	128.100	252.200	1.00	1.29
		35	128.110	252.210	1.00	1.29
		36	131.080	255.180	1.56	2.03
		37	135.090	259.190	1.29	1.67
		38	137.130	261.230	1.15	1.50
		39	142.595	266.695	1.28	1.66
		40	143.130	267.230	1.24	1.61
		41	150.100	274.200	1.32	1.71

Ratings controlled by Flexure unless noted.

Approach Results – Strengthened Girders – Interior Girder – Sheet 3 of 3

					STRENGTH I	
	Span	Point	x (ft)	x_c (ft)	IRF	ORF	
		1	0.000	274.200	1.32	1.71	
		2	7.505	281.705	1.52	1.97	
		3	10.000	284.200	1.57	2.04	
		4	15.010	289.210	1.64	2.13	
		5	19.000	293.200	1.74	2.26	
		6	22.040	296.240	1.71	2.22	
		7	22.063	296.263	1.61	2.09	
		8	22.515	296.715	1.64	2.12	
		9	25.050	299.250	1.77	2.29	
		10	25.063	299.263	1.77	2.29	
	3	11	28.063	302.263	1.90	2.46	
		12	30.020	304.220	1.96	2.54	
		13	36.630	310.830	2.16	2.80	
		14	37.525	311.725	2.21	2.86	
		15	45.030	319.230	2.17	2.81	
		16	46.130	320.330	2.08	2.70	
		17	50.050	324.250	2.35	3.04	
		18	52.535	326.735	2.24	2.91	
		19	60.040	334.240	2.02	2.62	
		20	67.545	341.745	1.89	2.45	
		21	75.050	349.250	1.86	2.41	CL of Unit
	MIN. OTHER THAN END PANEL SHEAR				1.00	1.29	

Ratings controlled by Flexure unless noted.

Section 5 Rehabilitation Options and Required Retrofits

5.1 Rehabilitation Options Considered

At this time, the following rehabilitation options are included in this report:

Truss Unit - For purposes of this report, the Truss Unit is considered to include the truss superstructure, Abutment 1 and Piers 1 through 3:

- Option T1 - Replace deck with conventional deck; perform required retrofits
- Option T2 - Replace deck with lightweight deck; perform required retrofits
- Option T3 - Add 6-foot sidewalks; replace deck with conventional deck; perform required retrofits
- Option T4 - Add 6-foot sidewalks; replace deck with lightweight deck; perform required retrofits

Approach Unit - For purposes of this report, the Approach Unit is considered to include the approach superstructure, Piers 4 through 8, and Abutment 2. The approach span steel is generally in good condition with some rating issues as noted in Section 2.5. Given the condition of the steel and limited locations needing strengthening, it appears renovation options are viable. Options A1 and A2 for the approach spans include renovation of the approach span steel. For comparison purposes, an additional option, Option A3, which includes complete replacement of the existing steel superstructure and deck slab, has been estimated. For Option A3, a new steel superstructure (as opposed to concrete superstructure in order to minimize weight on the existing substructure) has been assumed:

- Option A1 - Eliminate pin-and-hangers; replace deck with conventional deck; perform required retrofits
- Option A2 - Eliminate pin-and-hangers; add 6-foot sidewalks; replace deck with conventional deck; perform required retrofits
- Option A3 – Replace superstructure in its entirety with existing substructure to be retained; perform required retrofits on substructure only

5.2 Components to be Retrofitted Due to Rating Results

- Components with IRF < 0.90 will be repaired or strengthened.
- Components with ORF < 1.15 will be repaired or strengthened.
- NOTE - Repaired components shall have IRF > 1.00.

For the discussions and cost estimates which follow, the number of specific components to be retrofitted are based on these criteria for all of the live load cases previously described (HL93, Std. A, Std. B, Std. C, P411, and P413) for truss spans and (HL93) for approach spans. For Analysis 9 (Half width deck construction), only HL93 live loading was considered, as it has been assumed that permit vehicles could be precluded from the bridge during construction. For the truss components, it is important to note that in some cases, the number of locations that must be retrofitted based on these criteria increases significantly for the P411 and P413 permit live loadings, as compared to the other live load cases.

For example, based on Analysis 4 (New conventional deck), of the 93 primary truss members:

- 46 members require strengthening for the P413 live load case
- 34 members require strengthening for the P411 live load case
- 22 members require strengthening when all of the other load cases are considered

For Analysis 5 (New lightweight deck), of the 93 primary truss members:

- 24 members require strengthening for the P413 live load case
- 12 members require strengthening for the P411 live load case
- 4 members require strengthening when all of the other load cases are considered

However, for Analysis 10 (New Sidewalks with new conventional deck) the difference in terms of number of members requiring retrofits is not as significant (although the magnitude of the deficiencies may differ). Of the 93 primary truss members:

- 58 members require strengthening for the P413 live load case
- 54 members require strengthening for the P411 live load case
- 50 members require strengthening when all of the other load cases are considered

Similarly, for Analysis 12 (New Sidewalks with new lightweight deck), of the 93 primary truss members:

- 52 members require strengthening for the P413 live load case
- 42 members require strengthening for the P411 live load case
- 38 members require strengthening when all of the other load cases are considered

Charts showing the truss primary members and gusset plates that require retrofitting for the various live loadings for each of the analyses are provided in Appendix E.

Therefore, including the P413 and P411 permit live load case will have a significant impact on the cost of the retrofits for truss rehabilitation options that do not include the addition of cantilevered sidewalks.

It can be seen that, as would be expected, the options which add the 6-foot wide cantilever sidewalks on the outside of the existing truss (in combination with providing a new deck) necessitates the retrofit (strengthening) of more primary truss components than the option of providing only a new deck.

For the approach spans, both top and bottom flanges need to be reinforced in the negative moment regions of the exterior girders. In the case of the interior girders, it is sufficient to reinforce the bottom flange in the negative moment regions.

Two options are possible to reinforce the girder flanges in these regions, as shown in Figure 6. Option 1 consists of the addition of cover plates that are attached to the outer face of the existing L8x6x3/4 angles. In this case, the existing cover plates would need to be removed from the girder segment to install the new cover plates. In the exterior girder, for example, at Pier 4 (and 7), the 18x1/2x25'-0" and 18x1/2x13'-0" plates in the top and bottom flanges should be detached from the L8x6x3/4 angles, so new 18x1/2x46'-0" and 18x3/4x46'-0" plates can be installed.

In Option 2, two plate strips are installed in the inner side of the L8x6x3/4 angles. The benefit of this option is that there is no need to remove the existing cover plates; however, the rivets would still need to be removed to install the plate strips.

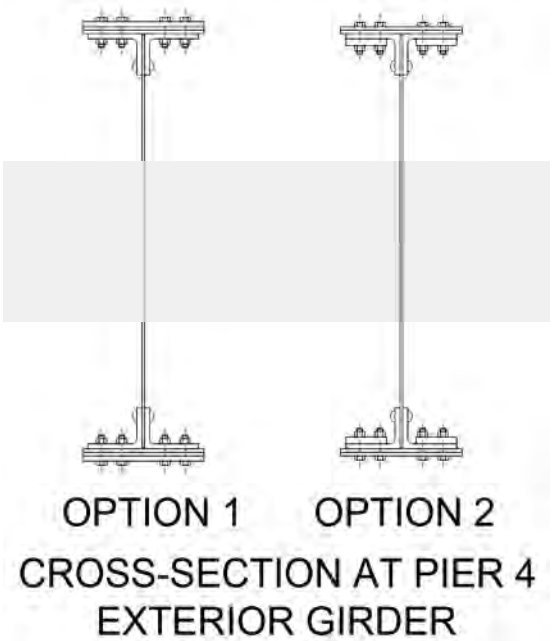


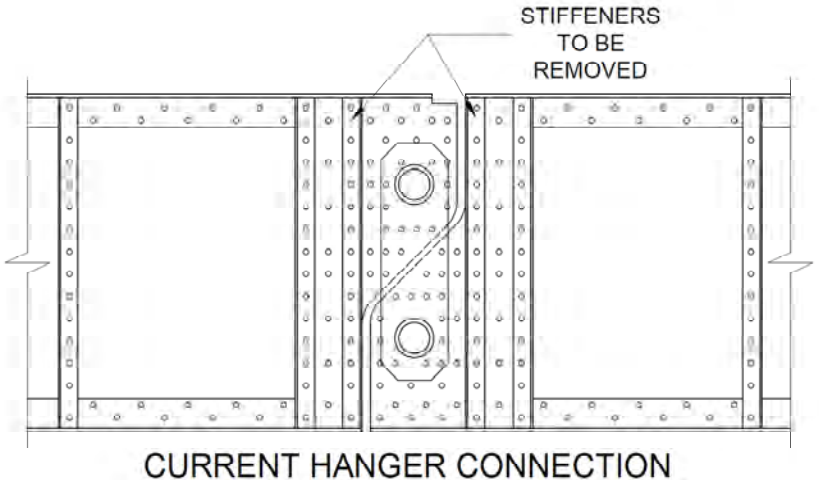
FIGURE 6 – GIRDER RETROFIT OPTIONS

In both cases, the intention would be to increase the flange cross-section so that the flexural girder capacity is also increased. The addition of top flange plates could be accomplished when

the deck is removed and bottom flange plates installed while the girders are supported on shoring for replacement of the bearings. Details for construction would be determined during final design, along with the appropriate step by step sequence of the retrofit and shoring concept options, which would be provided for the contractor in the final plan set.

As shown in the tables with the load rating factors, at the simple supports (Piers 3 and 8), the girders need to be reinforced to increase their shear strength capacity. This, however, does not represent a significant challenge since the strength in this "unanchored" panel can be increased by adding a transverse stiffener near the support.

In the case of the hanger locations, it is proposed to modify the connections as shown in Figure 7. In addition to pin and hangers, the transverse stiffeners indicated in the figure would need to be removed to open the space required to install web cover plates. These plates would be connected to the girder webs with bolts at the same rivet locations. Similarly, plates would be installed in the flanges to complete the moment connection.



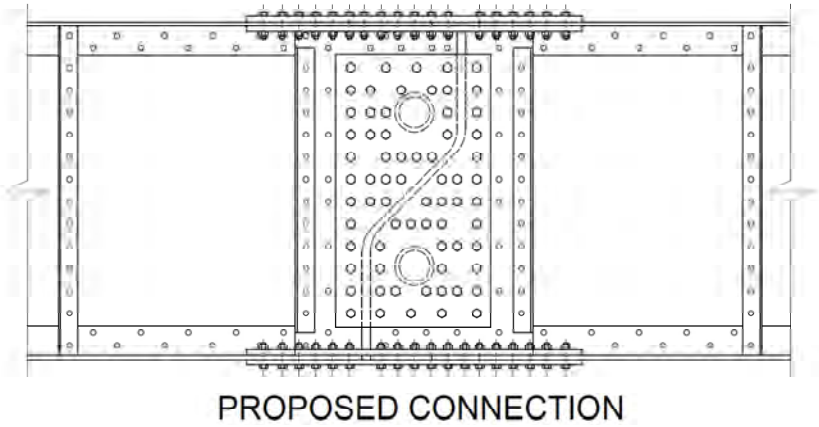


FIGURE 7 – MODIFIED CONNECTION AT HANGER LOCATIONS

5.3 Truss Unit Rehabilitation Work Includes

- Removal of the existing deck
- Make truss floorsystem members composite with new deck by adding shear studs
- Retrofit the welded coverplates on the truss floorbeam. Sample welded cover plate retrofit details from a previous project are provided in Appendix F, for information.
- Provide new deck and barriers. It has been assumed that the 3 existing finger joints at L8, L8' and at Pier 3 will be replaced with modular joints. The strip seal at the Minnesota abutment will be replaced with a new strip seal. The other strip seals at intermediate panel points in the truss deck will be eliminated, based on the findings of the preliminary analyses.
- Based on ratings, all four options (T1 through T4) considered, necessitated the retrofit (strengthening) of primary truss members, however only option T3 necessitated the retrofit of main truss gussets. The number and locations vary. Sample truss member and gusset strengthening details from a recent project are provided in Appendix F, for information.
- Perform miscellaneous minor truss repairs (i.e. retrofit/replace secondary members, pack rust treatment, drainage system modifications, etc.)
- Paint truss for all options considered
- For options that include new sidewalks, install new sidewalk brackets, sidewalk slab, and railings
- Perform retrofit of Piers 1 and 2 with concrete jacket for vessel collision, as described in Section 5.5.
- The analyses performed indicate that the truss pin and hangers are sufficient for strength (with rating factors >> 1.0). However, based on the fact that the high strength Q-T steel (Fy = 90 ksi) in the hanger plates may be susceptible to more brittle behavior than normal structural steel of the era, it would be recommended that these components continue to be inspected closely for the presence of any distress. Tack welds on the hanger or ring plates (immediately around the pin holes) have not been specifically identified in previous inspection reports, however, a closer examination for their presence is recommended and any tack welds identified should be tested for cracking using magnetic particle or UT testing. Pin testing, as performed in the past, should be continued.

5.4 Approach Unit Rehabilitation Work Includes

- Removal of the existing deck

- Make girders composite with new deck by adding shear studs
- Eliminate the approach girder pin-and-hangers in Spans 5 and 7 by providing bolted splices
- Strengthen approach girders for flexure by providing bolted plates to the girder flanges, as described in Section 5.2.
- Strengthen approach girders for shear by providing new stiffeners to the girder ends, as described in Section 5.2.
- Retrofit the welded coverplates on the approach girders. Sample welded cover plate retrofit details from a previous project are provided in Appendix F, for information.
- Provide new deck and barriers. It has been assumed that the 2 existing strip seals at Pier 8 and the Wisconsin abutment will be replaced with new strip seals. It has also been assumed that the other strip seals at pin-and-hanger locations in Spans 5 and 7 will be eliminated
- Modify or replace approach girder bearings (35 locations assumed)
- Perform miscellaneous minor steel repairs (i.e. retrofit/replace secondary members, drainage system modifications, etc.)
- Paint approaches for all options considered
- For options that include new sidewalks, modify existing piers, install new sidewalk girders, cast extended slab with new bridge deck, and install barriers/railings

5.5 Substructure Repairs/Retrofits

Based on the visual observations made along with a review of the recent bridge inspection reports, some degree of localized concrete repairs, such as crack sealing and spall repairs, will be required at all of the existing substructure units.

In addition, based on an initial analysis of the main river piers (Piers 1 and 2) for the prescribed barge impact loads, retrofits are warranted. Based on insufficient capacity of the existing concrete column and pier wall sections for bending and shear both parallel and perpendicular to the channel, a concrete jacket extending from the top of footing to an elevation above the impact point (which is above the current bottom of circular column) is required. The reinforcement for this jacket would be drilled into the existing footing, and placement of the jacket would require a cofferdam at Pier 2, and may require some shoring at Pier 1. Costs for these retrofits are included in the estimates in Section 6.

In addition, the pile foundations are a concern. At Pier 1, there are steel H-piles, and at Pier 2 there are timber piles. The analysis performed assumes that the vertical piles at each pier are subject to axial dead loads plus axial loads due to the overturning caused by the collision force. The battered piles are subject to these axial loads, plus additional axial load caused by lateral force from the collision load. We believe it is overly-conservative to assume that only the battered piles resist the lateral force, as some of this horizontal force would be resisted by passive resistance of the soil on the footings, lateral bending in the vertical piles, and possibly shared through system action to other substructure units (i.e. with the superstructure serving to transmit a portion of the force through diaphragm action). At this time, no foundation modifications have been included in the cost estimates in Section 6. **SEE NOTE BELOW.**

Should the bridge rehabilitation include the addition of new sidewalks, the most effective way of supporting new sidewalk girders at the approach piers must be investigated further. Options would include extending/encasing (and likely strengthening) the existing pier caps, or providing new separate columns (possibly founded on single drilled shafts) under the new girders.

These preliminary analyses have concluded that the additional dead and live loads (due to the addition of the 6 foot wide sidewalk) imposed on the piers supporting the truss unit would have a very minor effect. The main river piers (Piers 1 and 2) would be subjected to approximately 120 kips of additional dead load and a similar amount of sidewalk (pedestrian) live load. Given the number of piles present at Pier 1 (102 steel H-piles) and Pier 2 (264 timber piles), the additional load per pile would be quite low and the total pile loads would be well below the average bearing that was obtained during construction. **SEE NOTE BELOW.**

NOTE: HDR recently obtained copies of the original pile driving logs for this project from MnDOT. These logs indicate that the average bearing obtained during driving was significantly greater than the required bearing indicated on the design drawings. For the truss piers:

Pier 1: Average Bearing Obtained = 113 Tons ; Required Bearing = 50 Tons

Pier 2: Average Bearing Obtained = 130 Tons ; Required Bearing = 20 Tons

Pier 3: Average Bearing Obtained = 72 Tons ; Required Bearing = 20 Tons

For the cost estimates that follow in Section 6, a rough estimate of cost associated with the localized repairs is included. For options with sidewalks, truss piers would be adequate, and for the approach piers it has been assumed that new columns with drilled shafts will be utilized.

Substructure Settlement

The north abutment (Abutment 2) has experienced settlement in the past, but the latest inspection report dated May 6th 2010, states that the rate of settlement has slowed in recent years. To counter the settlement, the bridge seats at the north abutment have been raised to maintain original grades. The following repair criteria will be used to address settlement at the north abutment:

- Measure the seat elevations to determine if settlement is still on-going.
- Establish action plan with input from MnDOT that may involve repairs to the abutment.

Pier 8 has also experienced settlement and movement in the past, and was braced with steel members in 1972. The recent inspection report dated May 6th 2010 notes that the settlement rate has slowed in recent years. The following repair criteria will be used to address settlement at Pier 8:

- Measure the seat elevations to determine if settlement is still on-going.
- Inspect expansion bearings to determine if they are functioning as intended and can handle movement expected at pier.
- Establish action plan with input from MnDOT that may involve repairs to Pier 8.
- Determine whether bracing installed in 1972 should be replaced, with more permanent and visually appealing solution.

For the cost estimates that follow in Section 6, it has been assumed that some degree of repair or stabilization of Pier 8 and Abutment 2 will be desirable/required. A rough estimate of cost associated with this work has been included. At this time, it has been assumed that complete replacement of Pier 8 and Abutment 2 is not included in the rehabilitation. If it is determined that such replacement is warranted, it is likely that the additional cost (of these relatively small substructure units) would be covered within the "Miscellaneous Items Not Estimated" currently assumed for the cost estimates.

Section 6 Cost Estimates

6.1 Rehabilitation Options Estimated

At this time, the following separate cost estimates (Bridge Work Only) have been prepared:

Truss Unit - For purposes of this report, the Truss Unit is considered to include the truss superstructure, Abutment 1 and Piers 1 through 3:

- Option T1 - Replace deck with conventional deck; perform required retrofits
- Option T2 - Replace deck with lightweight deck; perform required retrofits
- Option T3 - Add 6-foot sidewalks; replace deck with conventional deck; perform required retrofits
- Option T4 - Add 6-foot sidewalks; replace deck with lightweight deck; perform required retrofits

Approach Unit - For purposes of this report, the Approach Unit is considered to include the approach superstructure, Piers 4 through 8, and Abutment 2:

- Option A1 - Eliminate pin-and-hangers; replace deck with conventional deck; perform required retrofits
- Option A2 - Eliminate pin-and-hangers; add 6-foot sidewalks; replace deck with conventional deck; perform required retrofits
- Option A3 – Replace superstructure in its entirety with existing substructure to be retained; perform required retrofits on substructure only

It should be noted that all cost estimates for this report have been escalated to 2018 construction dollars. Based on direction from MnDOT, a factor of 1.33 has been applied to the cost estimates that were determined using 2012 unit costs.

For each of these options, a Base Cost Estimate has been prepared. This estimate assumes that there would be no traffic on the bridge during the rehabilitation (this has been designated as Scheme 1 and would be utilized if a detour was viable or if a new adjacent bridge was constructed in advance of the rehabilitation). In addition, cost estimates have been prepared for each option for four additional traffic control schemes that would necessitate staged construction. The cost of the options for the four other schemes (Schemes 2 through 5 listed below) was computed using an adjustment factor applied to the base cost. These adjustment factors (also shown below) were determined by HDR's construction estimators based on labor and equipment inefficiencies, schedule impacts, traffic control costs and other relevant factors. The backup for the computation of these adjustment factors (for Option T4) is provided in Appendix G.

TRAFFIC CONTROL SCHEME	% INCREASE OF BASE COST
Scheme 2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation	20%
Scheme 3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day	30%
Scheme 4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day	50%
Scheme 5 - One lane closed during day, complete closure at night	35%

6.2 Cost Estimates and Summary

Individual Cost Estimates for Options T1 through T4 and A1 through A3 are provided in Appendix G. A summary of these cost estimates (Bridge Work Only) is provided in the table below:

REHABILITATION OPTION	SCHEME 1 (BASE COST)	TRAFFIC CONTROL SCHEME 2	TRAFFIC CONTROL SCHEME 3	TRAFFIC CONTROL SCHEME 4	TRAFFIC CONTROL SCHEME 5
T1	$22.4M	$31.1M	$36.6M	$45.4M	$37.9M
T2	$19.0M	$25.9M	$30.1M	$37.5M	$31.7M
T3	$27.7M	$38.6M	$45.7M	$56.6M	$47.1M
T4	$26.3M	$36.5M	$42.9M	$53.2M	$44.5M
A1	$8.1M	$10.7M	$12.2M	$15.2M	$13.2M
A2	$11.7M	$15.5M	$17.5M	$21.9M	$19.0M
A3	$5.8M	$7.6M	$8.6M	$10.8M	$9.3M

6.3 Total Estimated Cost for Rehabilitation Alternatives

Combinations of costs for truss and approach rehabilitation options to obtain a total estimated cost for rehabilitation (Bridge Work Only) is provided below for each traffic control scheme. Approach Option A1 (new deck without sidewalks) has only been combined with the Truss Options that do not include a new sidewalk (T1 and T2). Approach Option A2 (new deck and addition of 6' wide sidewalk) has only been combined with the Truss Options that include a new sidewalk (T3 and T4). Approach Option A3 (new approach superstructure on existing substructure) has only been combined with the Truss Options that do not include a new sidewalk (T1 and T2):

ALTERNATIVE	SCHEME 1 (BASE COST)	TRAFFIC CONTROL SCHEME 2	TRAFFIC CONTROL SCHEME 3	TRAFFIC CONTROL SCHEME 4	TRAFFIC CONTROL SCHEME 5
T1 + A1	**$30.5M**	**$41.8M**	**$48.8M**	**$60.6M**	**$51.1M**
T2 + A1	**$27.1M**	**$36.6M**	**$42.3M**	**$52.7M**	**$44.9M**
T3 + A2	**$39.4M**	**$54.1M**	**$63.2M**	**$78.5M**	**$66.1M**
T4 + A2	**$38.0M**	**$52.0M**	**$60.4M**	**$75.1M**	**$63.5M**
T1 + A3	**$28.2M**	**$38.7M**	**$45.2M**	**$56.2M**	**$47.2M**
T2 + A3	**$24.8M**	**$33.5M**	**$38.7M**	**$48.3M**	**$41.0M**

6.4 Basis for Cost Estimating

Unit costs used in the preparation of the cost estimates have generally been obtained from recent projects of similar character. The unit costs have been provided in Appendix G.

Appendix A

Matrix of Truss Rehabilitation Alternative Analyses

RED WING - MnDOT BRIDGE 9040
TRUSS - REHABILITATION STUDIES / RATING
DESCRIPTION OF ANALYSES

BY: MAB
DATE: 5/16/2012
CHKD: TAL
DATE: 5/16/2012

ANALYSIS DESIGNATION		METHODOLOGY						CONFIGURATION				DEAD LOADS						LIVE LOADS		
GENERAL GROUP	ANALYSIS	2D OR 3D	USING SOFTWARE	RATING METHOD	DESCRIPTION	BENEFIT OF RUNNING ANALYSIS	CAVEAT	DECK JOINT NUMBER AND LOCATION	ROADWAY WIDTH (FT)	INTERIOR SIDEWALK WIDTH (FT) AND LOCATION	CANTILEVER SIDEWALK WIDTH (FT) AND LOCATION	EQUIVALENT STEEL WT (PCF)	EQUIVALENT STEEL DETAIL %	DECK THICKNESS (IN)	EQUIVALENT DECK WEIGHT (PSF)	FWC (PSF)	BARRIER WEIGHT EACH BARRIER (PLF)	NUMBER OF LANES OF LL	DESIGN LL	PERMIT LL
ORIGINAL DESIGN	1	2D	BAR7	N/A	TO CONFIRM FORCES ON ORIGINAL PLANS	TO CONFIRM MODEL REFLECTS FORCES SHOWN ON ORIGINAL PLANS		N/A FOR 2D ANALYSIS	30'	2.5' RAISED BOTH SIDES	NONE	625	28%	7	87.50	NONE	225 - EXISTING	2	HS20	NONE
EXISTING CONFIGURATION	2	2D	BAR7	LFR	EXISTING CONDITIONS	TO DETERMINE LFR RATINGS FOR CURRENT STRUCTURE		N/A FOR 2D ANALYSIS	30'	2.5' RAISED BOTH SIDES	NONE	625	28%	8.5	106.25	NONE	225 - EXISTING	2	HS20	MNDOT LIST
	3	3D	LARSA	LFR	EXISTING CONDITIONS	TO COMPARE TO WSB RATINGS AND ASSESS 2D/3D DIFFERENCES		EXISTING CONFIG.	30'	2.5' RAISED BOTH SIDES	NONE	625	28%	8.5	106.25	NONE	225 - EXISTING	2	HS20	MNDOT LIST
NEW DECK ONLY	4	2D	BAR7	LRFR	NEW CONVENTIONAL DECK	MIN. SCOPE OF REHAB ; MOST COST-EFFECTIVE DECK OPTION		N/A FOR 2D ANALYSIS	28'	7' - 1 SIDE	NONE	625	28%	8.5	106.25	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	5	2D	BAR7	LRFR	NEW LIGHTWEIGHT DECK	MIN. SCOPE OF REHAB ; WILL SHOW BENEFIT TO PRIMARY TRUSS MEMBERS		N/A FOR 2D ANALYSIS	28'	7' - 1 SIDE	NONE	625	28%	TBD	70	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	6	2D	BAR7	LRFR	NEW LIGHTWEIGHT DECK WITH 3 LANES OF LIVE LOAD	DETERMINE IF 3 LANES IS AN OPTION IN ANY CIRCUMSTANCE		N/A FOR 2D ANALYSIS	35'	NONE	NONE	625	28%	TBD	70	NONE	350 - TYPE P-1	3	HL93	MNDOT LIST
	7	3D	LARSA	LRFR	NEW CONVENTIONAL DECK	DETERMINE 3D BENEFITS/IMPACTS - COMPARE TO ANALYSIS 4		EXISTING CONFIG.	28'	7' - 1 SIDE	NONE	625	28%	8.5	106.25	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	8	3D	LARSA	LRFR	NEW CONVENTIONAL DECK ; FEWER JOINTS	DETERMINE EFFECT OF JOINT ELIMINATION - COMPARE TO ANALYSIS 7		REDUCED JOINTS	28'	7' - 1 SIDE	NONE	625	28%	8.5	106.25	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	9	3D	LARSA	N/A	HALF NEW DECK	3D EFFECT OF HALF WIDTH CONSTRUCTION - COMPARE TO RUNS FOR FINAL CONDITION		REDUCED JOINTS	15' +/-	NONE	NONE	625	28%	8.5	106.25	NONE	350 - TYPE P-1; TEMP. BARRIER AT MIDDLE	1	HL93	NONE
NEW DECK AND NEW SIDEWALK	10	2D	BAR7	LRFR	NEW CONVENTIONAL DECK ; 6' EXTERIOR SIDEWALK (LIGHTWEIGHT) EA SIDE	DETERMINE IF 6' WALK WORKS WITH CONVENTIONAL DECK		N/A FOR 2D ANALYSIS	35'	NONE	6' EACH SIDE	625	28%	8.5	106.25	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	11	2D	BAR7	LRFR	NEW CONVENTIONAL DECK ; 10' EXTERIOR SIDEWALK (LIGHTWEIGHT) 1 SIDE	DETERMINE IF 10' WALK WORKS WITH CONVENTIONAL DECK	RUN ONLY IF 6' SIDEWALK IS OK	N/A FOR 2D ANALYSIS	35'	NONE	10' ONE SIDE	625	28%	8.5	106.25	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	12	2D	BAR7	LRFR	NEW LIGHTWEIGHT DECK ; 6' EXTERIOR SIDEWALK (LIGHTWEIGHT) EA SIDE	DETERMINE IF 6' WALK WORKS WITH LIGHTWEIGHT DECK		N/A FOR 2D ANALYSIS	35'	NONE	6' EACH SIDE	625	28%	TBD	70	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	13	2D	BAR7	LRFR	NEW LIGHTWEIGHT DECK ; 10' EXTERIOR SIDEWALK (LIGHTWEIGHT) 1 SIDE	DETERMINE IF 10' WALK WORKS WITH LIGHTWEIGHT DECK	RUN ONLY IF 6' SIDEWALK IS OK	N/A FOR 2D ANALYSIS	35'	NONE	10' ONE SIDE	625	28%	TBD	70	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	14	3D	LARSA	LRFR	NEW LIGHTWEIGHT DECK ; 6' EXTERIOR SIDEWALK (LIGHTWEIGHT) EA SIDE	DETERMINE 3D BENEFITS/IMPACTS - COMPARE TO ANALYSIS 12		REDUCED JOINTS	35'	NONE	6' EACH SIDE	625	28%	TBD	70	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
	15	3D	LARSA	LRFR	NEW LIGHTWEIGHT DECK ; 10' EXTERIOR SIDEWALK (LIGHTWEIGHT) 1 SIDE	DETERMINE 3D BENEFITS/IMPACTS - COMPARE TO ANALYSIS 13	RUN ONLY IF 6' SIDEWALK IS OK	REDUCED JOINTS	35'	NONE	10' ONE SIDE	625	28%	TBD	70	NONE	350 - TYPE P-1	2	HL93	MNDOT LIST
FINAL RUN (AFTER NEXT MEETING)	16	2D	BAR7	LRFR	CONFIG. FOR PREFERRED ALTERNATIVE - AFTER DISCUSSING RESULTS OF OTHER STUDIES	FINAL NUMBERS TO MOVE INTO NEXT PHASE														
	17	3D	LARSA	LRFR	CONFIG. FOR PREFERRED ALTERNATIVE - AFTER DISCUSSING RESULTS OF OTHER STUDIES	FINAL NUMBERS TO MOVE INTO NEXT PHASE														
SEE NOTES					(1)				(2)			(3)		(4)		(5)				

NOTES FOR TABLE:

(1) LIGHTWEIGHT DECK WOULD BE A SYSTEM SUCH AS EXODERMIC, PRECAST, ETC. BUT WILL NOT BE LIGHTWEIGHT CONCRETE OR OVERFILLED GRID

(2) FOR NEW DECK AND INTERIOR SIDEWALK THERE ARE NUMEROUS OPTIONS - THERE ARE MINOR DIFFERENCES FROM AN ANALYSIS STANDPOINT, SO A REPRESENTATIVE CONFIGURATION WILL BE USED - I.E. OPTION 2 SHOWN IN PREVIOUS SUBMITTAL
FOR NEW DECK WITH CANTILEVER SIDEWALK, 35' ROADWAY WILL BE USED - I.E. OPTION 4 SHOWN IN PREVIOUS SUBMITTAL

(3) BASED ON ORIGINAL PLAN INFORMATION (I.E. REACTIONS, QUANTITIES, MEMBER AREAS) - EQUIVALENT TO APPROXIMATELY 28% DETAIL PERCENTAGE

(4) FOR NEW CONVENTIONAL DECK, IT IS ASSUMED THAT THICKNESS WILL BE 8.5", STAINLESS REBAR USED
FOR NEW LIGHTWEIGHT DECK, A 70 PSF DECK WILL BE ASSUMED (THICKNESS VARIES DEPENDING ON TYPE OF LIGHTWEIGHT DECK USED)

(5) FOR NEW CONVENTIONAL DECK WITH STAINLESS REBAR - ASSUME NO FUTURE WEARING COURSE (FWC)
FOR NEW LIGHTWEIGHT DECK, AT THIS TIME IT IS ASSUMED THAT THERE WILL BE NO FWC

Appendix B

Current Version of Draft Bridge Criteria

MINNESOTA DEPARTMENT OF TRANSPORTATION (MnDOT)

DESIGN CRITERIA
BRIDGE NO. 9040
(T.H. 63 over Mississippi River and CP Railway)
AND
BRIDGE NO. 9103
(T.H. 63 over T.H. 61)

RED WING BRIDGE PROJECT
SP 2515-21

HDR Engineering, Inc.
HDR Project No. 177092

Revised Draft - November 2012

Section 1 General Provisions

1.1 Scope

The purpose of these criteria is to establish the specifications to be used for the Bridge Feasibility Study and Concept Evaluation for the Red Wing Bridge Project, which involves identifying the most promising and practical alternatives for the rehabilitation or replacement of Bridge No. 9040 and Bridge No. 9103.

1.2 Specifications

The project shall be designed in accordance with the following specifications:

- Minnesota Department of Transportation (MnDOT) LRFD Bridge Design Manual, Manual 5-392, current version.
- American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications, 5th Edition, 2010 and applicable interims.
- Secretary of the Interior's Standards for the Treatment of Historic Properties, as Adapted for Historic Bridges
- AASHTO The Manual for Bridge Evaluation, 2nd Edition, 2011 and applicable interims.
- AASHTO Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges, 2nd Edition, 2009
- MnDOT Bridge Preservation, Improvement and Replacement Guidelines, current version.
- AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002 and applicable interims.

1.3 Geometric Information

1.3.1 Design Speed

- Design Speed = 35 mph

1.3.2 Typical Section Information

Existing Bridge No. 9040

- 1 Lane each direction at 12'-0"
- 3'-0" wide shoulders
- 2'-6" wide raised curb on each side

- 1’-2” wide traffic barriers on each side

Note: The Project Team is considering different cross sections that can fit within existing truss and accommodate traffic and pedestrian/bicycle needs for the project. Rehabilitation alternatives will eliminate the 2’-6” wide raised curb to provide wider shoulders or a raised sidewalk on one side.

Existing Bridge No. 9103

- 2 Lanes each direction at 12’-0”
- 14’-0” wide shoulders
- 2’-6” raised curb on west side
- 5’-0” raised curb on east side
- 1’-6” wide ornamental metal railing on each side

Replacement Alternatives Bridge No. 9040

The final typical section for the replacement alternative has not been determined, but the following cross sections are under consideration.

4-Lane Divided Highway with trail – Two Separate Bridges with one bridge with trail and 50 ft 4 in Out-to-Out Deck

- 2 Lanes at 12’-0”
- 4’-0” shoulder on inside and 6’-0” shoulder on outside
- 12’-0” trail on one side, separated from traffic with 1’-6” wide barrier
- 1’-8” traffic barrier and 1’-2” combination barrier on outside of trail

2-Lane Highway with trail – Single Bridge with 60 ft 4 in Out-to-Out Deck

- 2 Lanes at 12’-0”
- 10’-0” shoulders on each side
- 12’-0” trail on one side, separated from traffic with 1’-6” wide barrier
- 1’-8” traffic barrier and 1’-2” combination barrier on outside of trail

4-Lane Highway with trail – Single Bridge with 86 ft 1 in Out-to-Out Deck

- 2 Lanes at 12’-0” in each direction
- 4’-0” shoulder on inside and 6’-0” shoulder on outside, for each direction

- 1'-9" wide median barrier (Note: The median width may vary depending on the structure type and construction staging selected)
- 12'-0" trail on one side, separated from traffic with 1'-6" wide barrier
- 1'-8" traffic barrier and 1'-2" combination barrier on outside of trail

Replacement Alternatives Bridge No. 9103

The typical cross section for Bridge No. 9103 replacement alternative has not been determined but most likely will match the cross section for Bridge No. 9040. Therefore the various cross sections for Bridge No. 9040 apply to Bridge No. 9103.

In addition, a new replacement structure for Bridge No. 9103 may need to provide a five-lane cross section to accommodate a left turn lane depending on the highway geometric layout selected.

1.3.3 Clearance

Main River Span Navigation Clearance (Mississippi River)

- Horizontal Clearance – 421 feet +/- existing clear distance. Assuming 421 feet will be required
- Vertical Clearance – 64.5 feet above normal pool existing. Assuming 64.5 feet will be required

  Note: Coast Guard coordination will not be complete until later in the project, therefore for initial designs/studies it is assumed that the existing clearances will be required for any new construction. Initial coordination with the Coast Guard has indicated that this is a valid assumption.

Horizontal Clearance

- From centerline of railroad tracks – 25 feet required (25 feet existing). Substructure protection to be provided in accordance with MnDOT LRFD Bridge Design Manual, if required.

Vertical Clearance

Bridge No. 9040

- Roadway - 16'-4" required (none existing). This criteria is only applicable if the project requires a structure that crosses over a roadway.
- Railroad - 23'-0" required (51 feet ± existing)
- Portal/through truss clearance - 20'-0" required per MnDOT LRFD Bridge Design Manual (20 feet ± existing)

Bridge No. 9103

- Roadway T.H. 61 Eastbound – 16'- 4" desired (shown as 15'-2 ½" existing plans, and 15'-6" structure inventory report). However, this criteria is subject to renovation study and historical considerations.
- Roadway T.H. 61 Westbound – 16'-4" desired (shown as 16'-1" existing plans, and 16'-5" structure inventory report)
- Roadway Service Road - 14'-6" required (shown as 14'-2 ½" existing plans, and 14'- 8" structure inventory report)

River Information

- Normal Pool Elevation – Elevation 667.00 (1912 Datum)
- Design (100-Year) Flood Elevation – Elevation 684.30 (1912 Datum)
- 2% Flowline – Elevation 683.00 (1912 Datum)

Section 2 Design Method

2.1 Superstructure Rehabilitation Alternative

2.1.1 Bridge No. 9040

- LRFR Ratings and LRFD Design
- Composite design where applicable
- Effects of potential Fracture Critical members will be considered in the analysis

2.1.2 Bridge No. 9103

- LRFR Ratings and LRFD Design

Bridge No. 9103 was determined to be eligible for listing in the National Register of Historic Places under Criterion C, in the area of engineering at the state level of significance. Therefore, any rehabilitation of Bridge No. 9103 should follow *Secretary of the Interior's Standards for the Treatment of Historic Properties, as Adapted for Historic Bridge*, which is provided in Appendix A.

2.2 Superstructure Replacement Alternative

2.2.1 Bridge No. 9040

- LRFD Design

2.2.2 Bridge No. 9103

- LRFD Design

2.3 Substructure Rehabilitation Alternative

2.3.1 Bridge No. 9040

- Load Factor Design and Service Load Methods

2.3.2 Bridge No. 9103

- Load Factor Design and Service Load Methods

2.4 Substructure Replacement Alternative

2.4.1 Bridge No. 9040

- LRFD Design

2.4.2 Bridge No. 9103

- LRFD Design

Section 3 Design Parameters and Loading

3.1 LRFD Design Factors

Load Modifiers relating to ductility, redundancy and operational importance are in accordance with MnDOT LRFD Bridge Design Manual Table 3.2.1, for the Strength Limit State:

Ductility, $\eta_D = 1.00$ for all structures

Redundancy, $\eta_R = 1.0$ except for components and connections that are found to be fracture critical, then use $\eta_R = 1.05$

Operational Importance, $\eta_I = 1.05$ for all superstructures only

For all other limit states, all load modifiers = 1.00

3.2 Structural Dead Loads

3.2.1 Concrete

Cast-in-place concrete including reinforcement = 150 pcf

3.2.2 Steel

Structural steel = 490 pcf

For replacement alternatives designs, the following detail percentages of main member weight shall be assumed:

- Plate Girders – 5% of Girders with stiffeners already accounted for

- Trusses – 20% of Main Truss Members (chords, diagonals, braces) – estimate floor system separately (Existing Truss Detail approximately 28%)
- Arches – 10% of Main Arch Members (tie, rib) – estimate floor system separately

3.3 Additional Dead Loads

No stay-in-place forms shall be considered for the project.

3.3.1 Barriers

Bridge railing (Existing Bridge No. 9040) = 200 plf (Each)

Bridge railing (Existing Bridge No. 9103) = 90 plf (Each)

Bridge railing (For Redecking/Rehabilitation) = 350 plf (Each) Concrete Parapet Type P-1 TL-2

Bridge railing (For Replacement Bridge) = 650 plf (Each) Concrete Barrier Type P-4 TL-4

Bridge railing (Ornamental Replacement) = 220 plf (Each)

3.3.2 Wearing Surface

Future Wearing Surface (DW) = 20 psf

3.3.3 Utilities

To Be Determined

3.4 Live Loads

3.4.1 Standard Truck and Lane Loads

Rating Existing Conditions: Standard AASHTO HS-20 Live Load

Rehabilitation and Replacement Alternatives: Standard AASHTO HL-93 Live Load

3.4.2 Load Reduction Factors for Multiple Lane Loading

Multiple presence factors per AASHTO LFRD except when evaluating live load deflections use 0.85 for load cases with more than 3 lanes.

3.4.3 Dynamic Load Allowance

Dynamic load allowance per AASHTO

3.4.4 Permit Vehicle Loads

Permit loads to be considered for this project are as follows:

- Standard A Truck: GVM = 104 kips, and Length = 46’-0”

- Standard B Truck: GVM = 136 kips, and Length = 49'-0"
- Standard C Truck: GVM = 159 kips, and Length = 57'-0"
- P411 Truck: GVM = 207 kips, and Length = 93'-0"
- P413 Truck: GVM = 255 kips, and Length = 117'-0"

3.4.5 Bicycle and Pedestrian Loads

Pedestrian loading of 75 psf and a maintenance vehicle equivalent to an H-10 Truck without the dynamic load allowance on sidewalk.

3.4.6 Live Load Deflection

Live load deflection = L/1000 (w/trail), L/800 (w/o trail)

3.4.7 Fatigue Loading

Fatigue loading in accordance with AASHTO LRFD shall be evaluated. Any new details used in a rehabilitation or replacement alternative shall be designed to have an infinite fatigue life, regardless of ADT.

3.5 Centrifugal and Braking Force

Centrifugal and braking force shall be in accordance with AASHTO LRFD

3.6 Vehicular Collision Force

Vehicular collision forces shall be in accordance with MnDOT LRFD Bridge Design Manual and MnDOT Memorandum to Designers 2007-01 Dated July 23, 2007.

3.7 Water Loads

Water loads shall be in accordance with MnDOT LRFD Bridge Design Manual.

3.8 Wind Loads

Wind loads shall be in accordance with AASHTO LRFD with design and velocity of 100 mph, and suburban surface conditions. For determination of wind loads applied to ornamental metal railing or chain link fence, assume that 30% of the rail or fence area is solid.

3.9 Ice Loads

Ice loads per AASHTO LRFD with ice thickness of 1.5 feet, crushing strength of 32 ksf. Ice load is applied at a height two-thirds of the distance from the flow line elevation to the 100-Year flood elevation.

3.10 Vessel Collision Force

Input from the Coast Guard is required to establish the largest tow for barge traffic within the vicinity of the bridge. Initial input suggests a largest tow of 3 barges wide by 5 barges long with 1500 tons per loaded barge. Also consider a 200 ton empty barge.

Vessel collision equivalent static loads shall be calculated in accordance with AASHTO LRFD and AASHTO Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges. The design loads perpendicular to the channel are 50% of the design loads parallel to the channel. For local impact design, the loading is applied as a distributed load in accordance with AASHTO LRFD Figure 3.14.14.1-3 with the barge point of impact at the elevations listed below. The design vessel barge is drafting fully loaded.

Design Loads Parallel to Channel at Bridge No. 9040 Piers 1 and 2

- Design Vessel Impact: 3000 kips parallel to channel at 5' above the 2% flow line Elevation 683.00 (1912 Datum)
- Empty Barge Impact: 470 kips parallel to channel at 5' above the 100-Year flood Elevation 684.30 (1912 Datum)

3.11 Thermal Effects

Thermal effects shall be in accordance to MnDOT LRFD Bridge Design Manual for Non-typical Bridges for Bridge No. 9040, and Typical Bridges for Bridge No. 9103.

3.12 Earth Pressure

Earth load is assumed to be 120 pcf for structural backfill.

For Full Active Earth Pressure conditions, the lateral equivalent fluid pressure shall be 33 pcf.

For At-Rest Earth Pressure conditions, the lateral equivalent fluid pressure shall be 60 pcf.

3.13 Earthquake Effects

Earthquake effects shall be in accordance with AASHTO LRFD for Seismic Performance Zone 1 with acceleration coefficient of 3%.

3.14 Construction Loadings

Construction Loadings shall be dependent on structure type and in accordance with MnDOT LRFD Bridge Design Manual.

Section 4 Analysis and Rating Methodology

4.1 General

4.1.1 Bridge No. 9040

Bridge No. 9040 constructed in 1958 consists of 9 spans with a total length of 1,631 feet. The 6 approach spans consist of continuous steel multi-beam spans. The 3 main river spans consist of a continuous cantilever Warren steel through truss.

Classical truss design procedures (which appear to have been used for the design of this bridge, consistent with the era of design) utilized 2D analyses to determine the anticipated forces in the truss members and gusset plates. These analyses included a 2D analysis of the primary truss members in the plane of one truss, and assumed that these primary members would carry the primary (dead and live) loads. Primary members would be subject to the secondary forces, as evidenced by the wind loads shown on the original stress sheet for this bridge. These secondary (wind) forces in the primary members were often determined by performing separate 2D analyses for the framing in the plane of the top and bottom chords. Typically, however, the magnitude of these secondary forces in the primary members (when compared to dead and live load forces) along with the prescribed load combinations (which in ASD design have different allowable stresses) would not typically control the design of the members. When they did control, the design of the primary members would include their effect.

The secondary truss members (bracing) would carry only secondary forces (such as wind), determined from the 2D analyses in the planes of the top and bottom chords. Floor system members (stringers and floorbeams) were designed using 2D line girder type analyses.

Based on past experience, we have determined that the use of a 3D model to determine member forces in the primary members of trusses may lead to unconservative results, or results that aren't consistent with the original design methodology. This results from the fact that the deck and bracing members which are included in the 3D model carry a portion of the DL and LL, and tend to show greater load sharing between truss lines than would be predicted using lever-rule distribution factors. While a 3D model may predict slightly lower forces in the primary members, it is likely not prudent to count on the secondary members to resist primary loads, since they weren't designed for such forces.

This topic was discussed at the meeting held at the MnDOT office in Oakdale on April 27, 2012. At that meeting, MnDOT stated that they had observed similar behavior in previous truss analyses. The decision was made that in general, 2D analyses for the various truss rehabilitation/modification schemes would conservatively be used to determine member forces in the floor system and primary truss members, which would be used to determine load ratings for the truss. However, it was decided that several 3D analyses would be run to confirm the anticipated behavior and assess the magnitude of the force reduction in the primary truss members.

A redundancy study is not required for the project, but the Project Team will investigate improvements to member design that reduce potential for fracture (i.e. stress range reductions or connection detail improvements).

The continuous steel multi-beam approach spans (spans 4 through 9) load rating analysis will be performed using AASHTO software program VIRTIS.

4.1.2 Bridge No. 9103

Bridge No. 9103 constructed in 1958 consists of 5 spans with a total length of 211 feet measured along centerline of roadway, and is a continuous concrete slab bridge.

The concrete slab bridge load rating analysis will be performed using AASHTO software program VIRTIS.

4.2 Rating and Evaluation Methodology

Based on direction from MnDOT, ratings for the existing condition are to be based on the LFR rating methodology, while all ratings computed for future (rehabilitated/modified) conditions would be based on the LRFR rating methodology.

4.2.1 LFR Ratings

Based on the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011, Section 6B.4, the general form of the LFR Rating Equation is defined as:

$$RF = \frac{C - A_1 D}{A_2 L(1+I)} \qquad (6B.4.1\text{-}1)$$

where:

RF = The rating factor for the live load carrying capacity. The rating factor multiplied by the rating vehicle in tons gives the rating of the structure (see Eq. 6B.4.1-2)

C = The capacity of the member (see Article 6B.5)

D = The dead load effect on the member (see Article 6B.6.1). For composite members, the dead load effect on the noncomposite section and the dead load effect on the composite section need to be evaluated when the Allowable Stress method is used

L = The live load effect on the member (see Article 6B.6.2)

I = The impact factor to be used with the live load effect (see Article 6B.6.4)

A_1 = Factor for dead loads (see Articles 6B.4.2 and 6B.4.3)

A_2 = Factor for live load (see Articles 6B.4.2 and 6B.4.3)

A_1 and A_2 vary depending on the desired rating level (inventory or operating)

For:

Inventory Level Ratings (IRF), $A_1 = 1.3$ and $A_2 = 2.17$

Operating Level Ratings (ORF), $A_1 = 1.3$ and $A_2 = 1.3$

4.2.2 LRFR Ratings

Based on the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011, Section 6A.4, the general form of the LRFR Rating Equation is defined as:

$$RF = \frac{C - (\gamma_{DC})(DC) - (\gamma_{DW})(DW) \pm (\gamma_P)(P)}{(\gamma_{LL})(LL + IM)} \qquad (6A.4.2.1\text{-}1)$$

For the Strength Limit States:

$$C = \varphi_c \varphi_s \varphi R_n \qquad (6A.4.2.1\text{-}2)$$

Where the following lower limit shall apply:

$$\varphi_c \varphi_s \geq 0.85 \qquad (6A.4.2.1\text{-}3)$$

For the Service Limit States:

$$C = f_R \qquad (6A.4.2.1\text{-}4)$$

where:

RF = Rating factor

C = Capacity

f_R = Allowable stress specified in the LRFD code

R_n = Nominal member resistance (as inspected)

DC = Dead load effect due to structural components and attachments

DW = Dead load effect due to wearing surface and utilities

P = Permanent loads other than dead loads

LL = Live load effect

IM = Dynamic load allowance

γ_{DC} = LRFD load factor for structural components and attachments

γ_{DW} = LRFD load factor for wearing surfaces and utilities

γ_p = LRFD load factor for permanent loads other than dead loads = 1.0

γ_{LL} = Evaluation live load factor

φ_c = Condition factor

φ_s = System factor

φ = LRFD resistance factor

Table 6A.4.2.3-1—Condition Factor: φ_c

Structural Condition of Member	φ_c
Good or Satisfactory	1.00
Fair	0.95
Poor	0.85

Table C6A.4.2.3-1—Approximate Conversion in Selecting φ_c

Superstructure Condition Rating (SI & A Item 59)	Equivalent Member Structural Condition
6 or higher	Good or Satisfactory
5	Fair
4 or lower	Poor

For the condition factor for this project, a value of 0.95 has been assumed per MnDOT direction. Considering Table C6A.4.2.3-1, it is likely that this factor could be increased to 1.00, given the condition of the structural steel on the bridge.

Table 6A.4.2.4-1—System Factor: φ_s for Flexural and Axial Effects

Superstructure Type	φ_s
Welded Members in Two-Girder/Truss/Arch Bridges	0.85
Riveted Members in Two-Girder/Truss/Arch Bridges	0.90
Multiple Eyebar Members in Truss Bridges	0.90
Three-Girder Bridges with Girder Spacing 6 ft	0.85
Four-Girder Bridges with Girder Spacing ≤4 ft	0.95
All Other Girder Bridges and Slab Bridges	1.00
Floorbeams with Spacing >12 ft and Noncontinuous Stringers	0.85
Redundant Stringer Subsystems between Floorbeams	1.00

For the system factor for this project, the following factors were assumed:

- Truss Stringers 1.00
- Truss Floorbeams 0.85
- Truss Riveted Truss Members 0.90
- Approach Girders 1.00

It should be noted, that using the values listed above for condition factor and system factors, the following are the combined reduction in strength of particular members used in the ratings (not including the LRFD resistance factors that must also be applied):

- Truss Stringers 0.95
- Truss Floorbeams 0.808, which is < 0.85, therefore use 0.85
- Truss Riveted Truss Members 0.855
- Approach Girders 1.00

A list of additional assumptions that were used for the development of these ratings includes:

- The LFR rating computations (specifically with respect to the calculation of member capacities) was in accordance with the 17th Edition AASHTO Standard Specifications for Highway Bridges with reference to the AASHTO Guide Specifications for Strength Design of

Truss Bridges (Load Factor Design), where applicable, and the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011.

- The LRFR rating computations (specifically with respect to the calculation of member capacities) was in accordance with the 5th Edition AASHTO LRFD Bridge Design Specifications, with reference to the AASHTO Manual for Bridge Evaluation, 2nd Edition, 2011.
- Inventory (IRF) and Operating (ORF) ratings (for vertical load effects only) are provided for each component for the design live load (either HS20 or HL93) and ORF are provided for permit vehicles.
- Truss members have been rated for axial loads only (neglecting shear and flexure considerations).
- Truss gusset plates have been rated using normal MnDOT assumptions, procedures and spreadsheet tools.
- Approach span girders have been rated for both flexure and shear.

4.2.3 Repair Criteria

- Components with $RF_{inv} < 0.90$ for the design vehicle or $RF_{op} < 1.15$ for permit vehicles will be repaired or strengthened.
- Repaired components shall have $RF_{inv} > 1.00$

4.2.4 Substructure Settlement

The north abutment has experienced settlement in the past, but the latest inspection report dated May 6th 2010, states that the rate of settlement has slowed in recent years. To counter the settlement, the bridge seats at the north abutment have been raised to maintain original grades. The following repair criteria will be used to address settlement at the north abutment:

- Measure the seat elevations to determine if settlement is still on-going.
- Establish action plan with input from MnDOT that may involve repairs to abutment.

Pier 8 has also experienced settlement and movement in the past, and was braced with steel members in 1972. The recent inspection report dated May 6th 2010 notes that the settlement rate has slowed in recent years. The following repair criteria will be used to address settlement at Pier 8:

- Measure the seat elevations to determine if settlement is still on-going.

- Inspect expansion bearings to determine if they are functioning as intended and can handle movement expected at pier.
- Establish action plan with input from MnDOT that may involve repairs to Pier 8.
- Determine whether bracing installed in 1972 should be replaced, with more permanent and visually appealing solution.

For the preliminary cost estimates to be used in preliminary studies, it has been assumed that some degree of repair or stabilization of Pier 8 and Abutment 2 will be included in any rehabilitation work.

4.3 Material Properties

4.3.1 Existing Bridge No. 9040

Structural Steel

Plan Designation- Structural Steel - MHD 3305: Fy = 33 ksi, Fu = 60 ksi

Plan Designation – Intermediate Strength Manganese Copper Bearing Structural Steel: Fy = 42 ksi, Fu = 65 ksi

Plan Designation - Phosphorous Chromium Steel - MHD 3309: Fy = 47 ksi, Fu = 67 ksi

Plan Designation - Girder Hanger Pins - MHD 3313

Girder Hanger Plates Phosphorous Chromium Steel - MHD 3309: Fy = 47 ksi, Fu = 67 ksi

Plan Designation - Truss Hanger Pins MHD 3315

Truss Hanger Plates - Q-T Low Alloy Struct. Steel (Type I) MHD 3318: Fy = 90 ksi, Fu = 105 ksi
(Based on specification information available)

Concrete

Concrete: f'c = 3,000 psi

Reinforcing Steel

Reinforcing Steel: Fy = 36 ksi, fs = 20 ksi

4.3.2 Existing Bridge No. 9103

Concrete

Concrete: f'c = 3,000 psi

Reinforcing Steel

Reinforcing Steel: Fy = 36 ksi, fs = 20 ksi

4.3.3 Replacement Alternatives

Structural Steel

Structural Steel ASTM A709 (AASHTO M270) Grade 50W Fy = 50 ksi and Grade HPS 70W Fy = 70 ksi

Concrete

Superstructure Deck: f'c = 4,000 psi

Substructure – Abutments and Piers: f'c = 4,000 psi

Substructure – Footing: f'c = 4,000 psi

Reinforcing Steel

Reinforcing Steel: Fy = 60 ksi

Epoxy Reinforcing Steel: Fy = 60 ksi

Stainless Steel Deck Reinforcing (ASTM A955): Fy = 75 ksi

Section 5 Potential Replacement Structure Types

5.1 Bridge No. 9040

Possible options where river clearance dictates shallow depth

- Steel Through Truss Bridge
- Redundant Tied Arch Bridge
- Cable-Stayed Bridge

Possible options for new alignments with raised profile

- Precast Segmental Concrete Box Girder Bridge
- Extradosed Bridge
- Steel Plate Girder or Box Girder Bridge

5.2 Bridge No. 9103

- Concrete Slab Bridge
- Prestressed Concrete Beam Bridge
- Steel Plate Girder Bridge

Appendix A

Secretary of the Interior's Standards for the Treatment of Historic Properties, as Adapted for Historic Bridges

Adapted from:
Clark, Kenneth M., Grimes, Mathew C., and Ann B. Miller, *Final Report, A Management Plan for Historic Bridges in Virginia*, Virginia Transportation Research Council, 2001.

The Secretary of the Interior's Standards for the Treatment of Historic Properties, first codified in 1979 and revised in 1992, have been interpreted and applied largely to buildings rather than engineering structures. In this document, the differences between buildings and structures are recognized and the language of the Standards has been adapted to the special requirements of historic bridges.

1. Every reasonable effort shall be made to continue an historic bridge in useful transportation service. Primary consideration shall be given to rehabilitation of the bridge on site. Only when this option has been fully exhausted shall other alternatives be explored.

2. The original character-defining qualities or elements of a bridge, its site, and its environment should be respected. The removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided.

3. All bridges shall be recognized as products of their own time. Alterations that have no historical basis and that seek to create a false historical appearance shall not be undertaken.

4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.

5. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.

6. Deteriorated structural members and architectural features shall be retained and repaired, rather than replaced. Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.

7. Chemical and physical treatments that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the most environmentally sensitive means possible.

8. Significant archaeological and cultural resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.

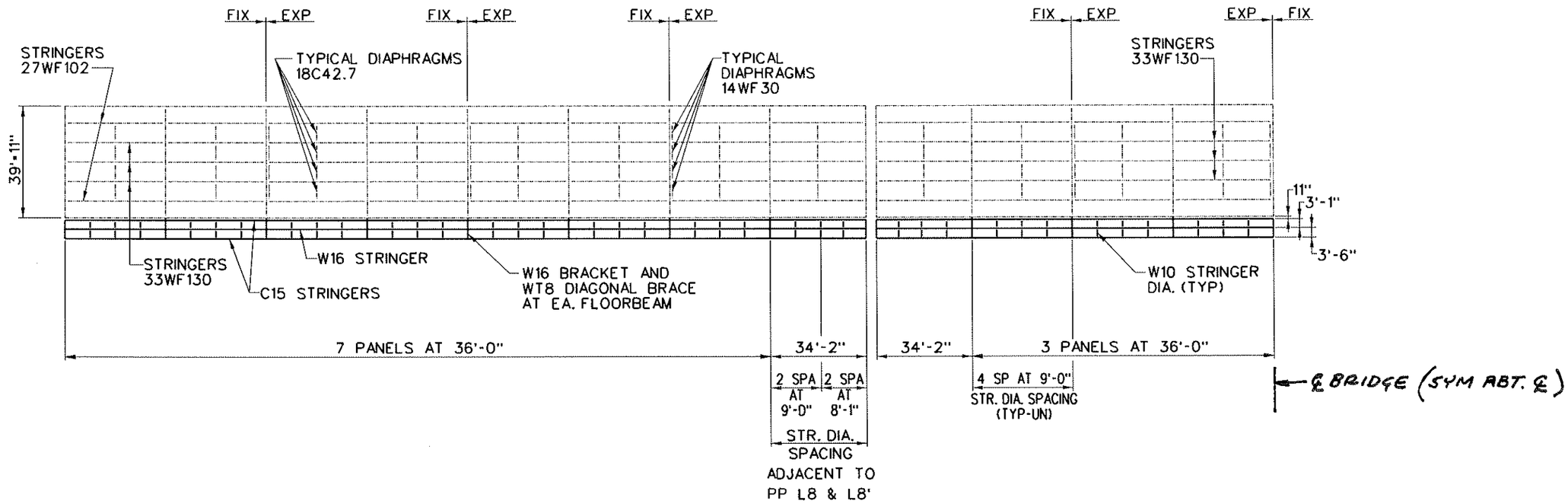
9. New additions, exterior alterations, structural reinforcements, or related new construction shall not destroy historic materials that characterize the property. The new work shall be

differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

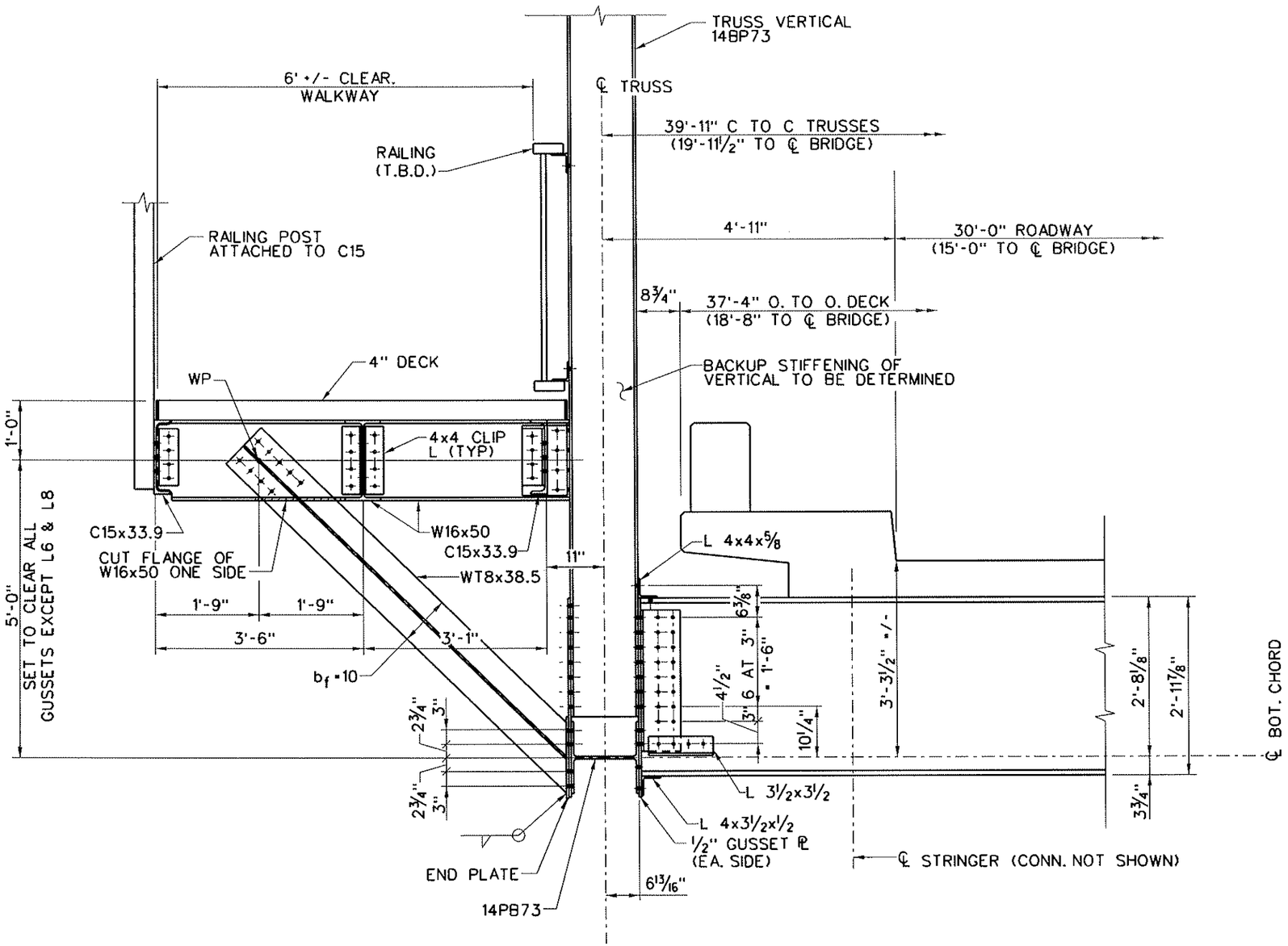
Appendix C

Conceptual Cantilever Sidewalk Details



FRAMING PLAN

SCALE 1"=20'-0"



TYPICAL BRACKET SECTION

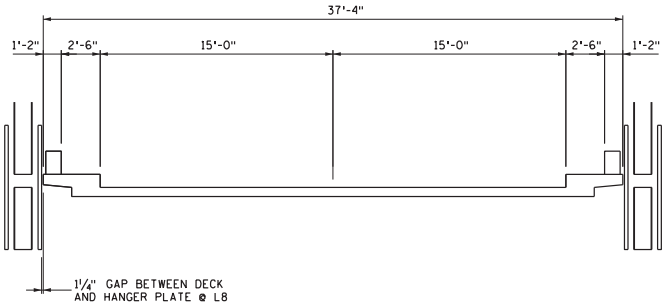
(SHOWN AT P.P. L1)
SCALE 1"=1'-0"

C2

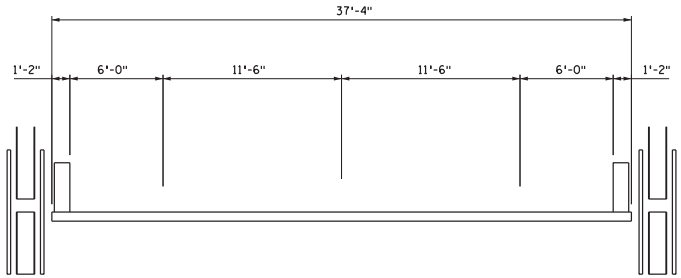
DES: MAB | DWG: MM | CKD: XXX

Appendix D

Cross-Section Options within the Existing Truss



EXISTING



OPTION 1A

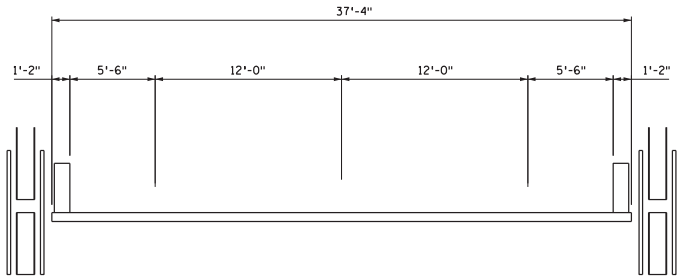
CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 1A PROS:

1. PROVIDES 6'-0" MINIMUM SHOULDER FOR URBAN DESIGN.

OPTION 1A CONS:

1. 11'-6" LANES LESS THAN 12'-0" STANDARD.
2. NO RAISED OR BARRIER SEPARATED SIDEWALK FOR PEDESTRIANS.



OPTION 1B

CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 1B PROS:

1. PROVIDES STANDARD LANE WIDTH OF 12'-0".
2. PROVIDES GREATER THAN 4'-0" MINIMUM SHOULDER AT 5'-6" BUT REMAINS LESS 6'-0" MINIMUM FOR URBAN DESIGN.

OPTION 1B CONS:

1. NO RAISED OR BARRIER SEPARATED SIDEWALK FOR PEDESTRIANS.

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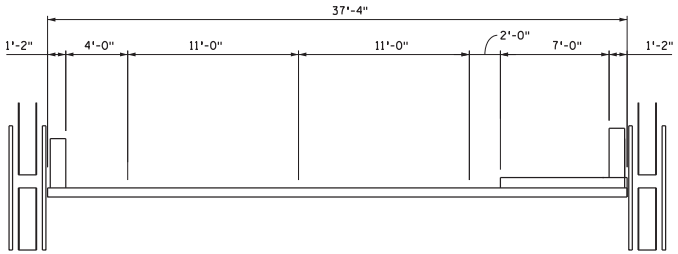
HDR Engineering, Inc.

RED WING BRIDGE TYPICAL SECTIONS	DES:	DR:	BRIDGE NO. 9040
	CHK:	CHK:	
STATE PROJECT NO. XXXX-XXXXX	SHEET NO. 1 OF 4 SHEETS		



OPTION 2A

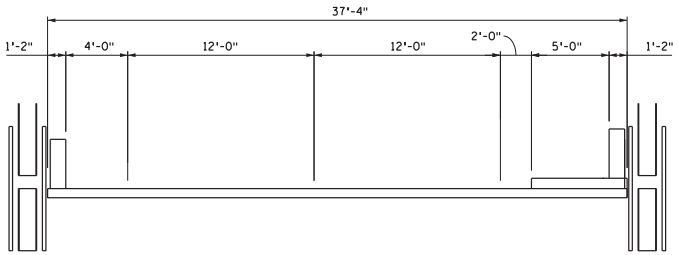
CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 2A PROS:

1. PROVIDES PEDESTRIAN WALKWAY WIDTH GREATER THAN 6'-0" MINIMUM.
2. PROVIDES MINIMUM 4'-0" SHOULDER BUT REMAINS LESS THAN 6'-0" MINIMUM FOR URBAN DESIGN.
3. LOW COST SOLUTION.

OPTION 2A CONS:

1. BICYCLISTS HAVE INADEQUATE SHOULDER WIDTH AND RAISED SIDEWALK NOT DESIRED FOR BICYCLES.
2. 11'-0" LANES LESS THAN 12'-0" STANDARD.
3. POSSIBLE WIDE LOAD RESTRICTIONS.



OPTION 2B

CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 2B PROS:

1. PROVIDES 12'-0" LANES AND 4'-0" MINIMUM SHOULDER BUT REMAINS LESS THAN 6'-0" MINIMUM FOR URBAN DESIGN.
2. LOW COST SOLUTION.

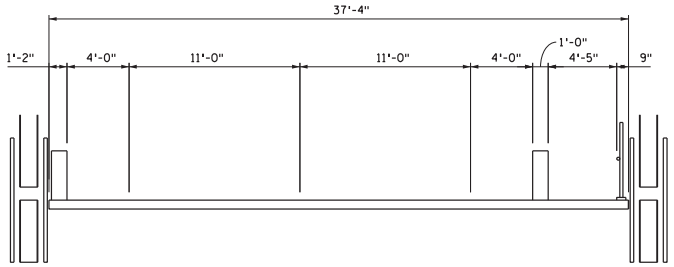
OPTION 2B CONS:

1. SIDEWALK WIDTH LESS THAN 6'-0" MINIMUM.
2. BICYCLISTS HAVE INADEQUATE SHOULDER WIDTH AND RAISED SIDEWALK NOT DESIRED FOR BICYCLES.
3. POSSIBLE WIDE LOAD RESTRICTIONS.

HDR Engineering, Inc.

RED WING BRIDGE TYPICAL SECTIONS | DES: | DR: | CHK: | CHK:

STATE PROJECT NO. XXXX-XXXXX | SHEET NO. 2 OF 4 SHEETS | BRIDGE NO. 9040



OPTION 3A

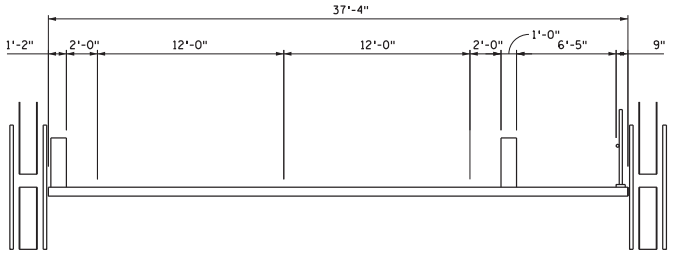
CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 3A PROS:

1. PROVIDES MINIMUM 4'-0" SHOULDER BUT REMAINS LESS THAN 6'-0" MINIMUM FOR URBAN DESIGN.
2. PROVIDES BARRIER SEPARATION FOR PEDESTRIAN AND TRAIL USERS FROM ROADWAY.
3. LOW COST SOLUTION.

OPTION 3A CONS:

1. SIDEWALK WIDTH LESS THAN 6'-0" MINIMUM.
2. BICYCLISTS HAVE MINIMAL SHOULDER AND INADEQUATE SIDWALK WIDTH.
3. 11'-0" LANES LESS THAN 12'-0" STANDARD.
4. POSSIBLE WIDE LOAD RESTRICTIONS.



OPTION 3B

CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH

OPTION 3B PROS:

1. PROVIDES SIDEWALK WIDTH GREATER THAN 6'-0" MINIMUM.
2. PROVIDES BARRIER SEPARATION FOR PEDESTRIANS AND TRAIL USERS FROM ROADWAY.
3. LOW COST SOLUTION.

OPTION 3B CONS:

1. SHOULDER WIDTH LESS THAN 4'-0" MINIMUM.
2. BICYCLISTS HAVE INADEQUATE SHOULDERS AND INADEQUATE SIDEWALK WIDTH.
3. POSSIBLE WIDE LOAD RESTRICTIONS.

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3:21:40 PM
5/10/2012
\\mnspe-srv1\ECGCAD5\proj\ds\MN007_BR_V8\PLOTDRV\MN007_PLT
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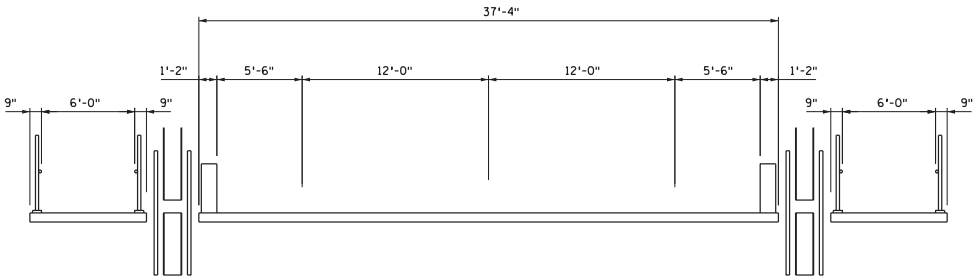
c:\bework\ng\cmo\d81941\RW_sections.dgn

HDR Engineering, Inc.	RED WING BRIDGE TYPICAL SECTIONS	DES: / DR: / CHK: / CHK:	BRIDGE NO. 9040
	STATE PROJECT NO. XXXX-XXXXX	SHEET NO. 3 OF 4 SHEETS	



OPTION 4

CONCRETE PARAPET (TYPE P-1, TL-2) FOR DESIGN SPEED LESS THAN 40 MPH WITH CANTILEVER SIDEWALK

OPTION 4 PROS:

1. PROVIDES STANDARD LANE WIDTH OF 12'-0".
2. PROVIDES OPTION FOR BICYCLISTS TO USE ROADWAY SHOULDER OR TRAIL.
3. SEPARATES TRAIL USERS FROM ROADWAY AND PROVIDES DUAL WALKWAYS.
4. PROVIDES WIDEST SHOULDER AT 5'-6" BUT REMAINS LESS 6'-0" MINIMUM FOR URBAN DESIGN.

OPTION 4 CONS:

1. HIGHEST COST SOLUTION FOR ADDING PEDESTRIAN FACILITIES.

HDR Engineering, Inc.

RED WING BRIDGE TYPICAL SECTIONS

DES: | DR:
CHK: | CHK:

STATE PROJECT NO. XXXX-XXXXX

SHEET NO. 4 OF 4 SHEETS

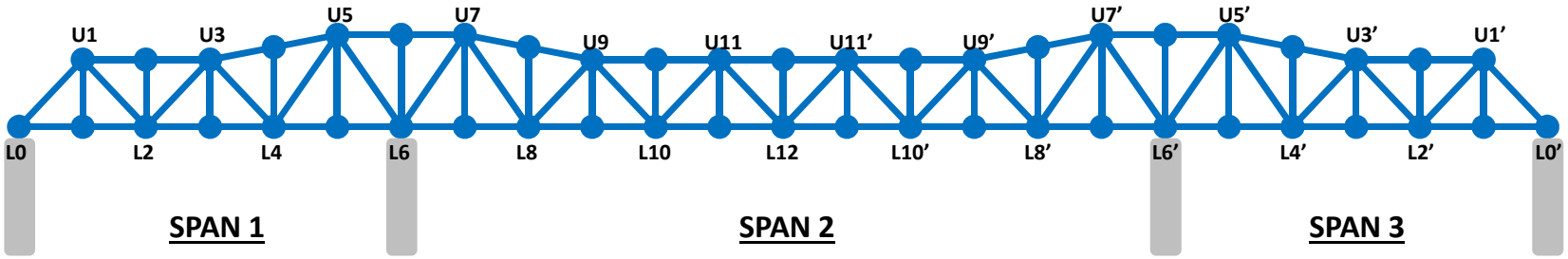
BRIDGE NO. 9040

Appendix E

Truss Member and Gusset Retrofit Charts

RED WING - MnDOT BRIDGE 9040

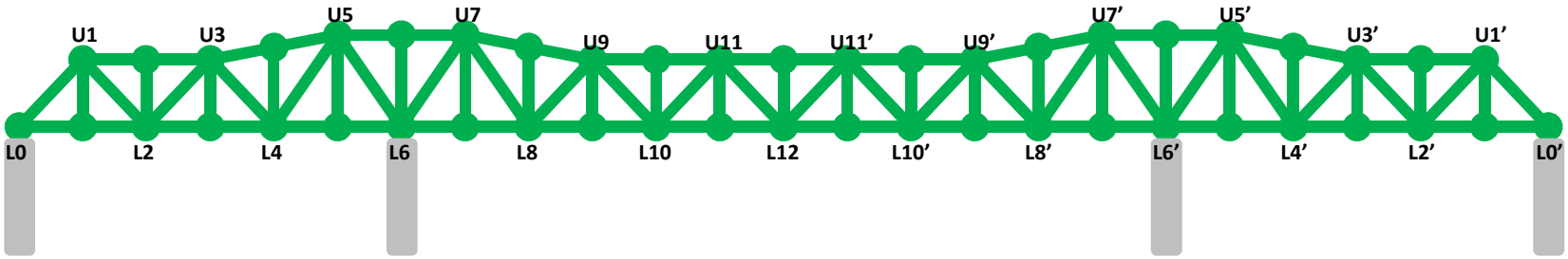
TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



TRUSS JOINT LOCATIONS

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

MEMBER
GUSSET PLATE

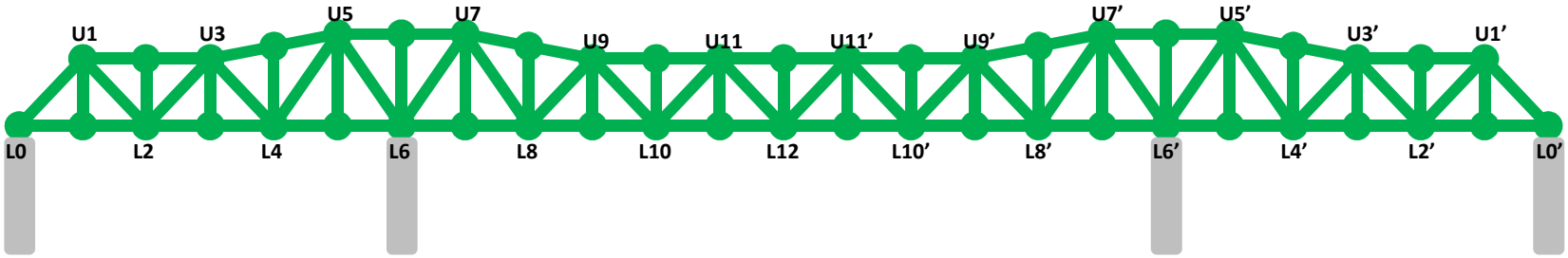
IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

ANALYSIS – 2
LIVE LOAD – HS20-44

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

MEMBER
GUSSET PLATE

IRF < 0.90 or ORF < 1.15

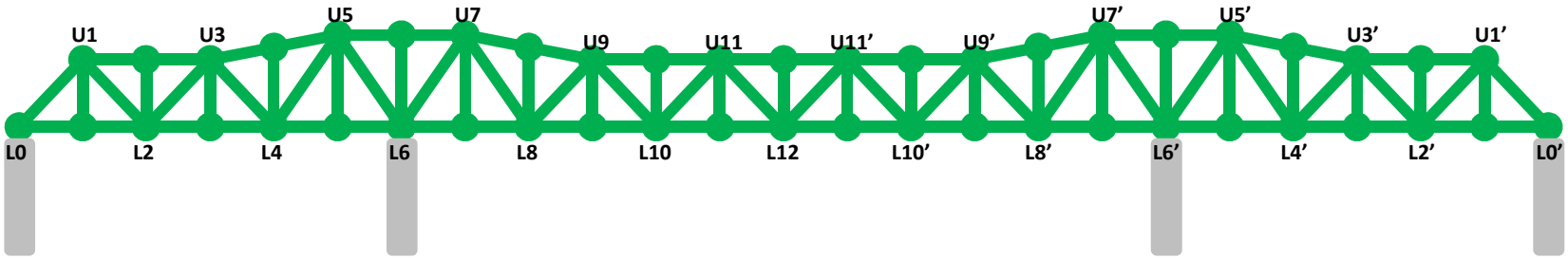
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 2
LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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GUSSET PLATE

IRF < 0.90 or ORF < 1.15

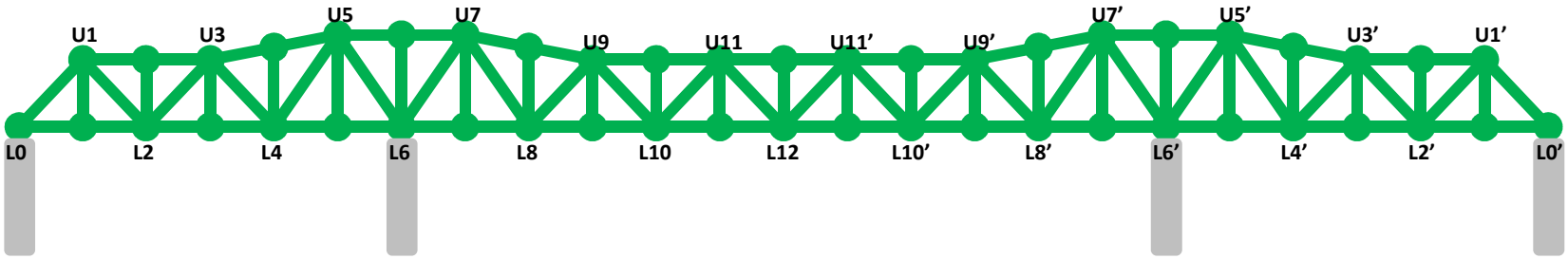
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 2
LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

MEMBER
GUSSET PLATE

IRF < 0.90 or ORF < 1.15

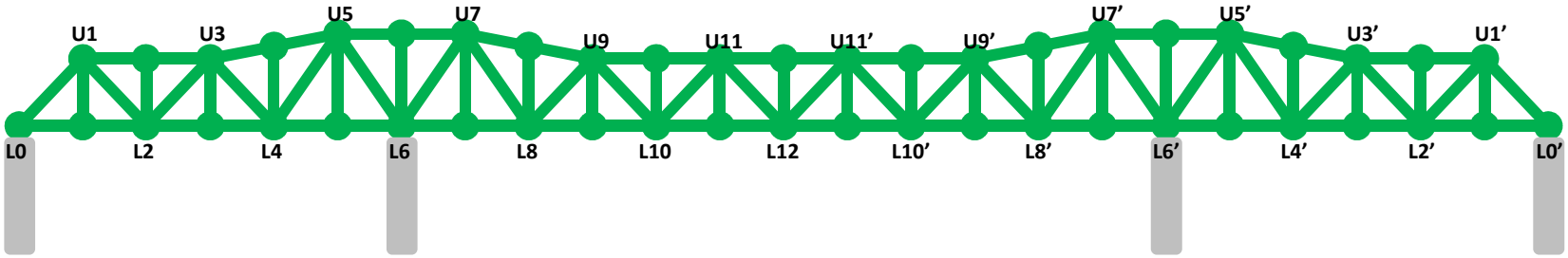
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 2
LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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GUSSET PLATE

IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

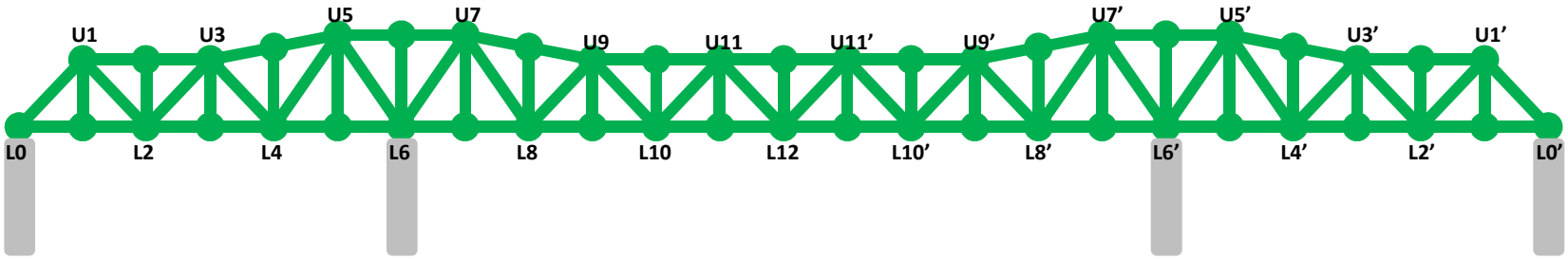
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 2
LIVE LOAD – P411

PAGE E6

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

MEMBER
GUSSET PLATE

IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

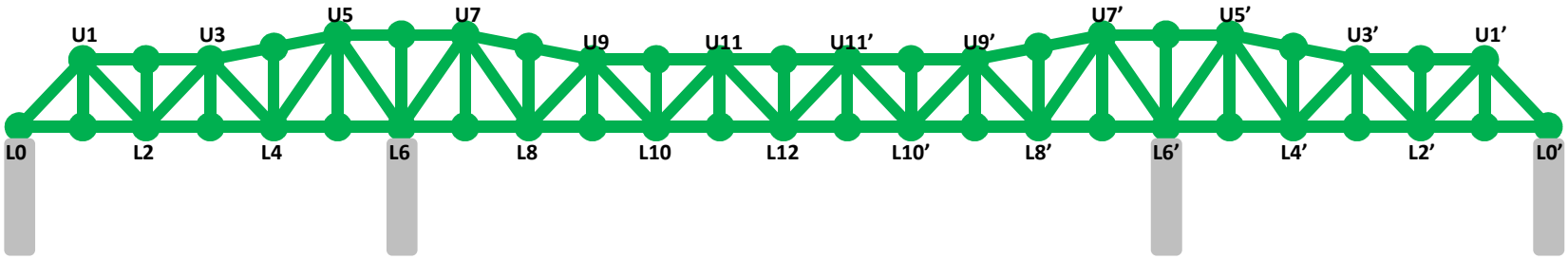
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 2
LIVE LOAD – P413

PAGE E7

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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GUSSET PLATE

IRF < 0.90 or ORF < 1.15

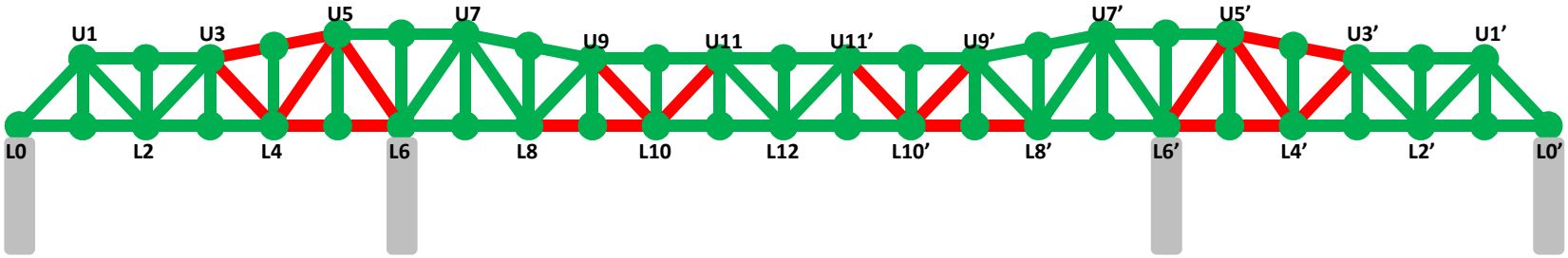
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 3
LIVE LOAD – HS20-44

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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MEMBER
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IRF < 0.90 or ORF < 1.15

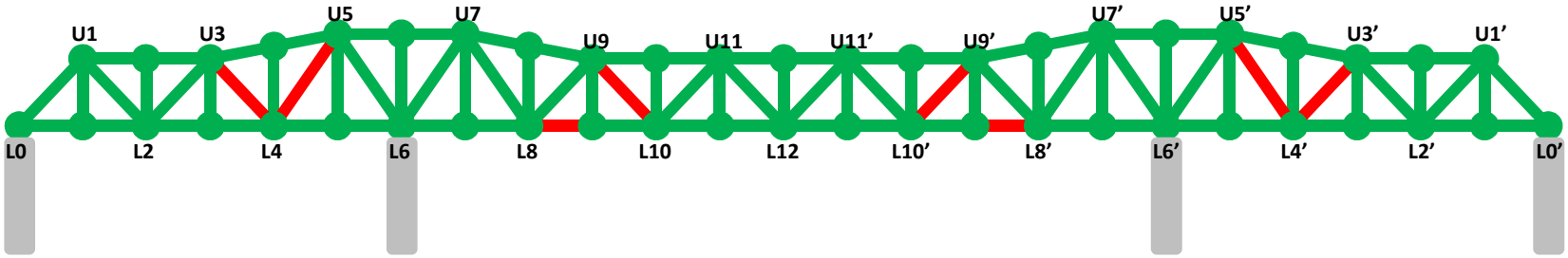
MEMBER
GUSSET PLATE

ANALYSIS - 4
LIVE LOAD – HL93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER

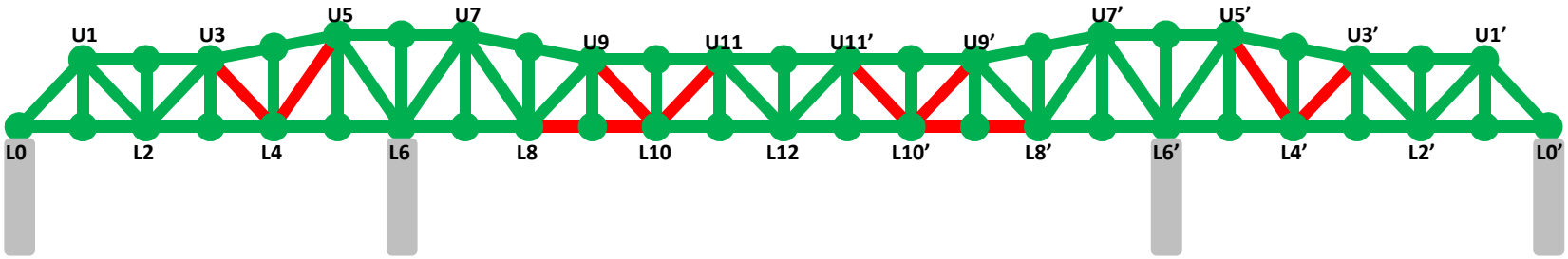
GUSSET PLATE

ANALYSIS – 4

LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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IRF < 0.90 or ORF < 1.15

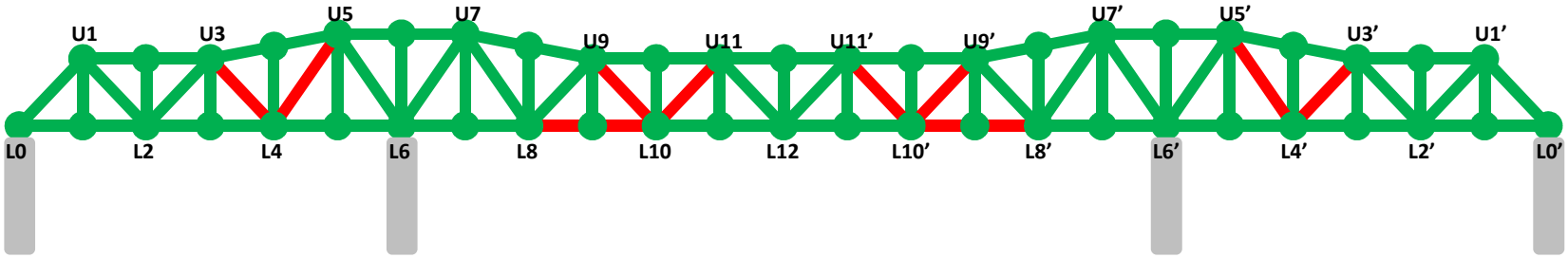
MEMBER
GUSSET PLATE

ANALYSIS – 4
LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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GUSSET PLATE

IRF < 0.90 or ORF < 1.15

MEMBER

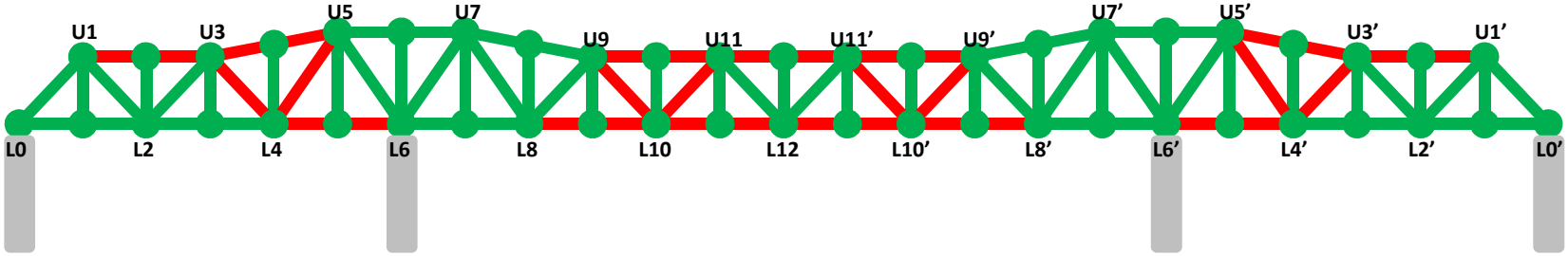
GUSSET PLATE

ANALYSIS – 4

LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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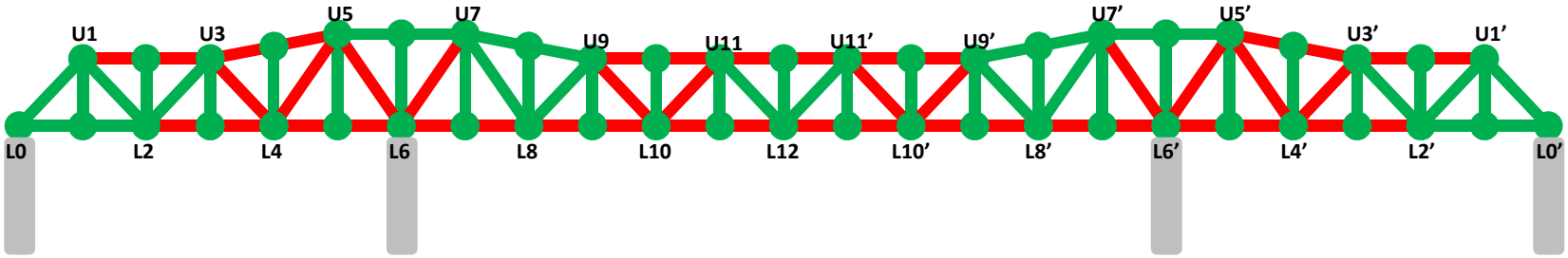
IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

ANALYSIS – 4
LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

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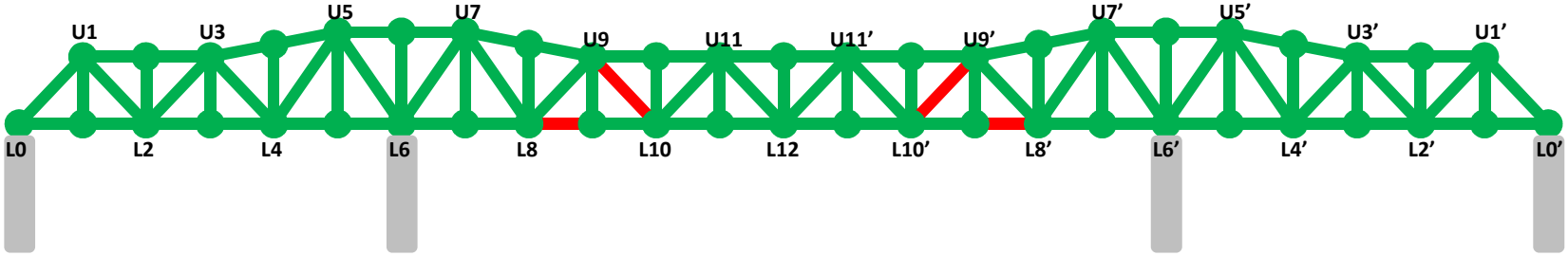
ANALYSIS – 4
LIVE LOAD – P413

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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IRF < 0.90 or ORF < 1.15

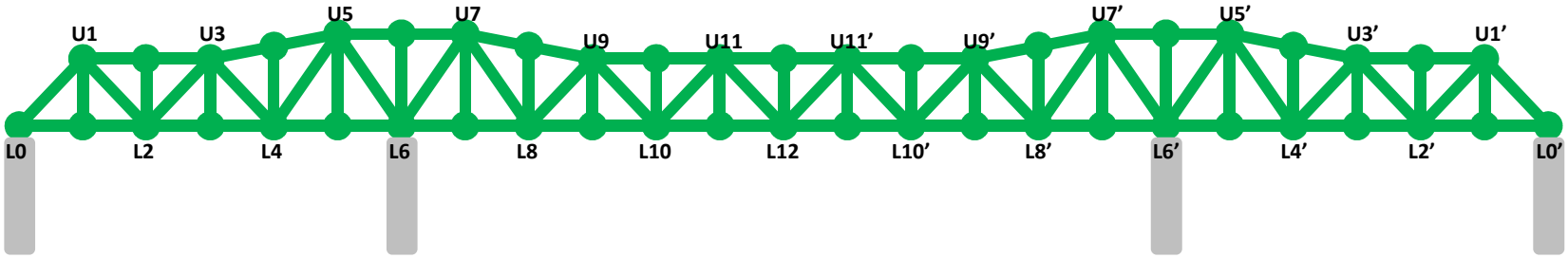
MEMBER
GUSSET PLATE

ANALYSIS – 5
LIVE LOAD – HL-93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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MEMBER

GUSSET PLATE

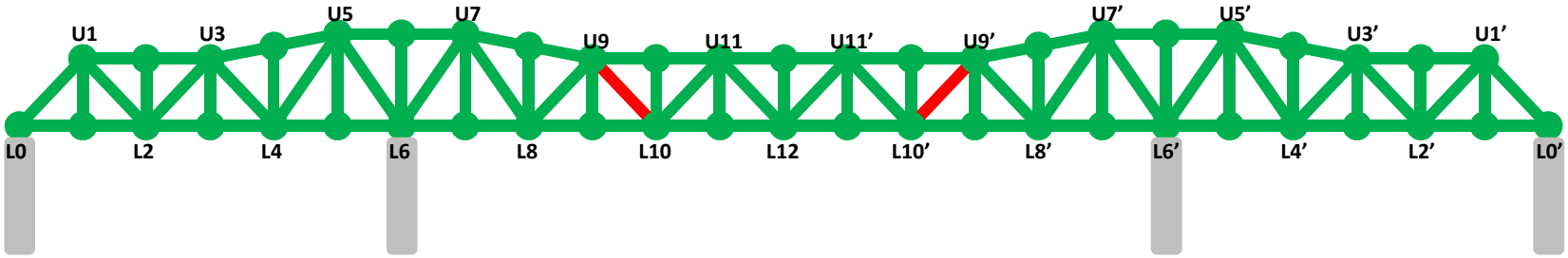
ANALYSIS – 5

LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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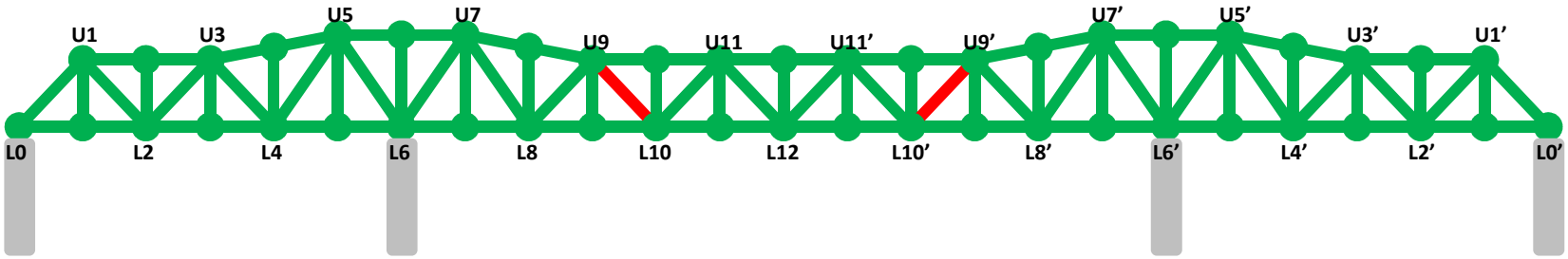
ANALYSIS – 5

LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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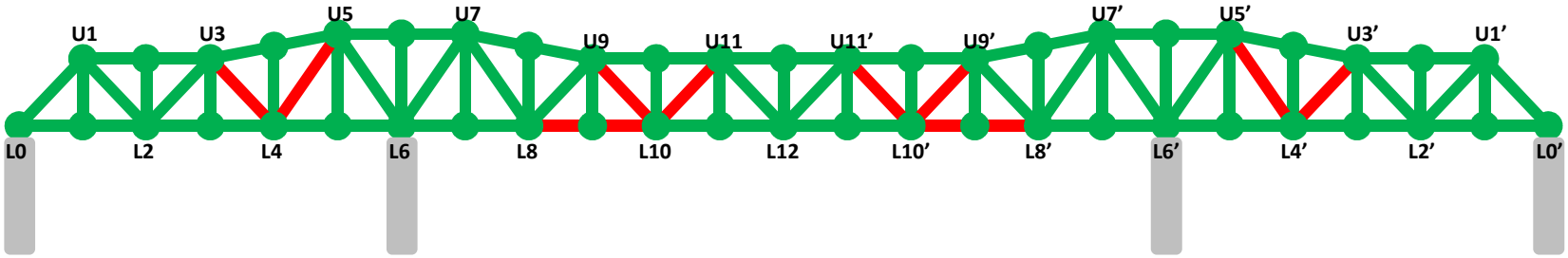
ANALYSIS – 5

LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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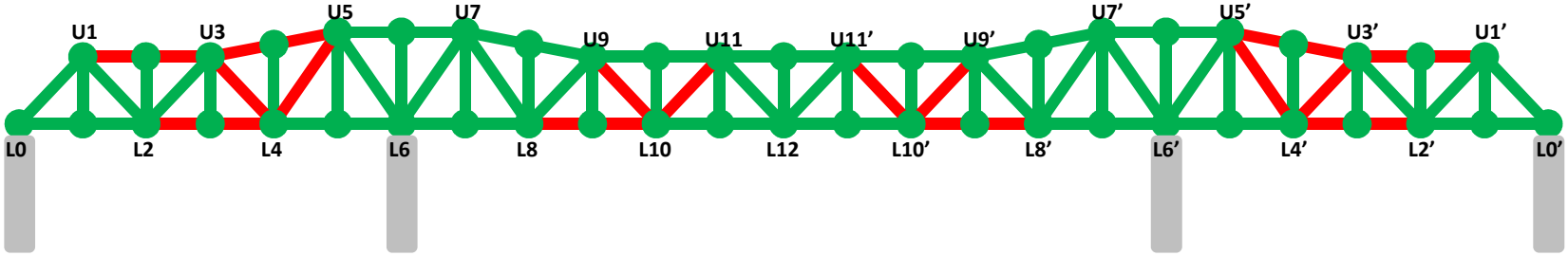
ANALYSIS – 5
LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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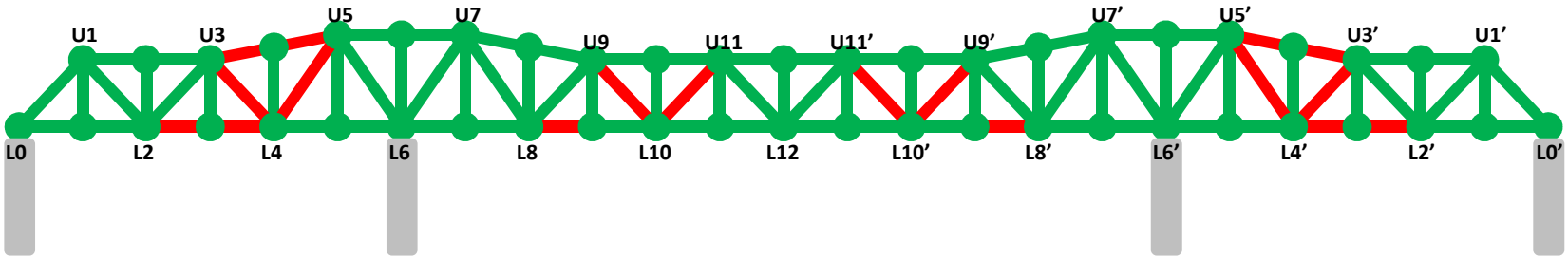
ANALYSIS – 5
LIVE LOAD – P413

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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IRF < 0.90 or ORF < 1.15

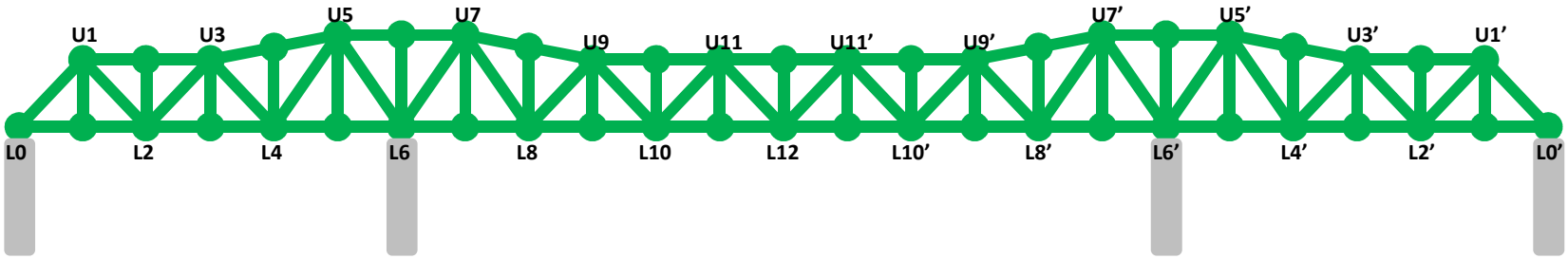
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS - 6
LIVE LOAD – HL93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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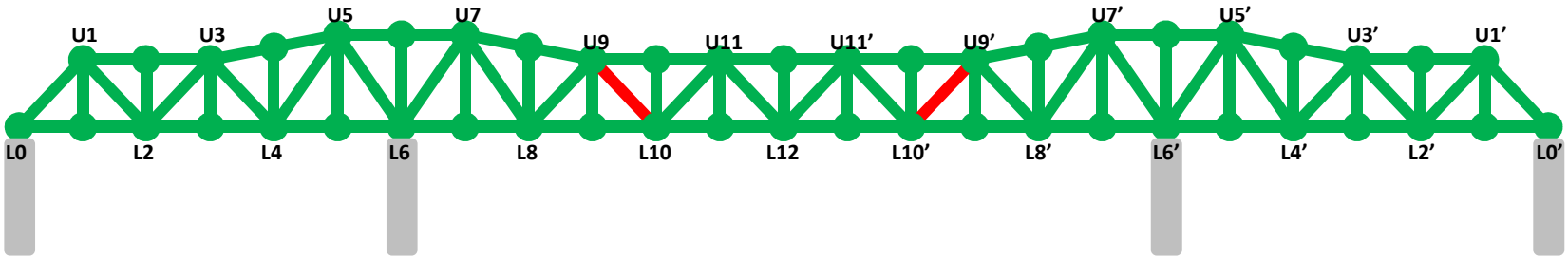
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 6
LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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MEMBER
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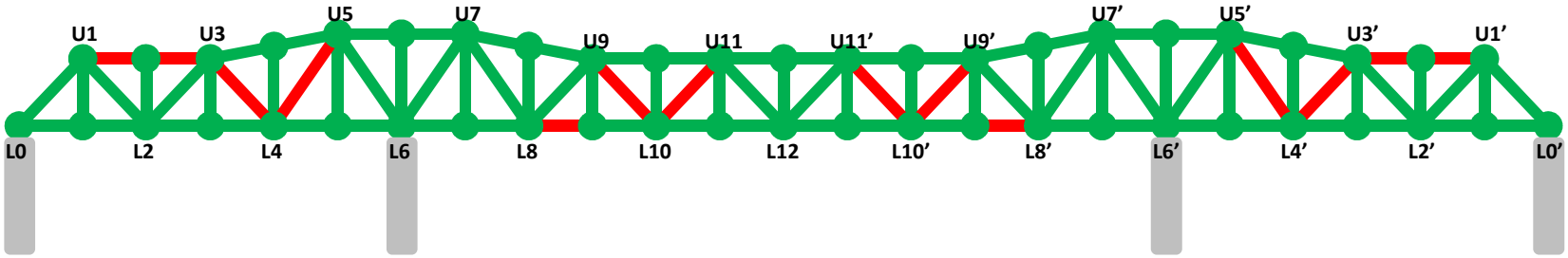
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 6
LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

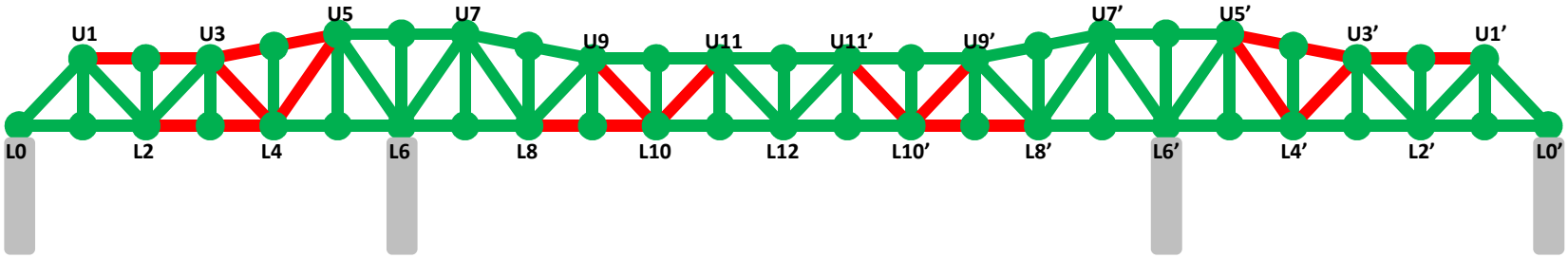
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 6
LIVE LOAD – STD C.

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

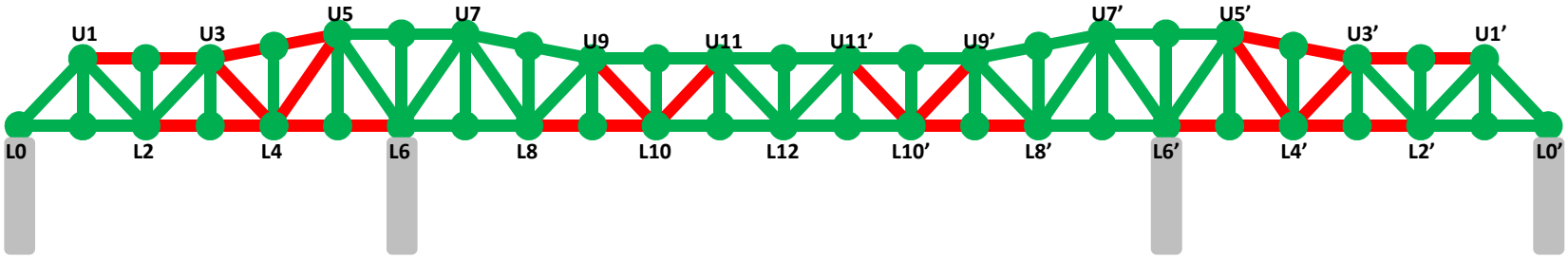
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 6
LIVE LOAD – P411

PAGE E25

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

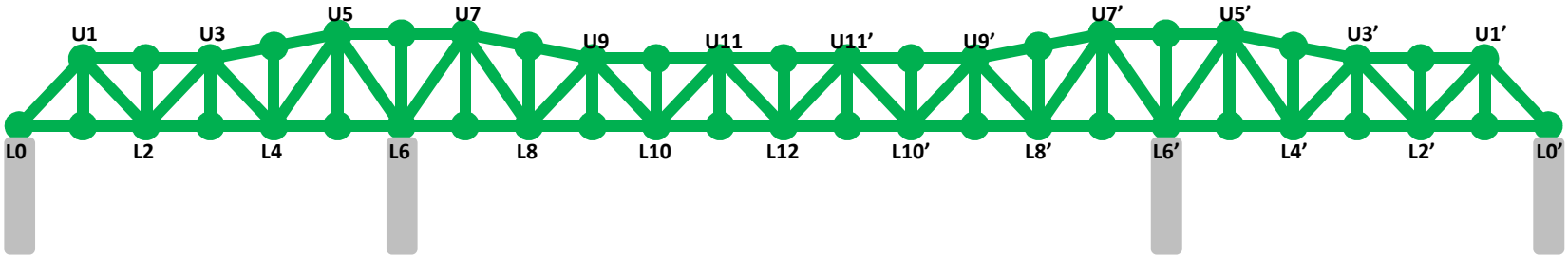
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 6
LIVE LOAD – P413

PAGE E26

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

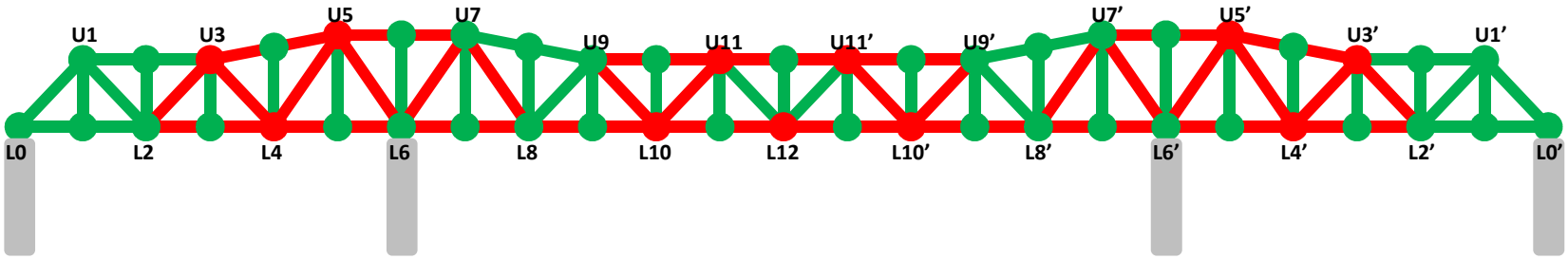
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS - 9
LIVE LOAD – HL93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

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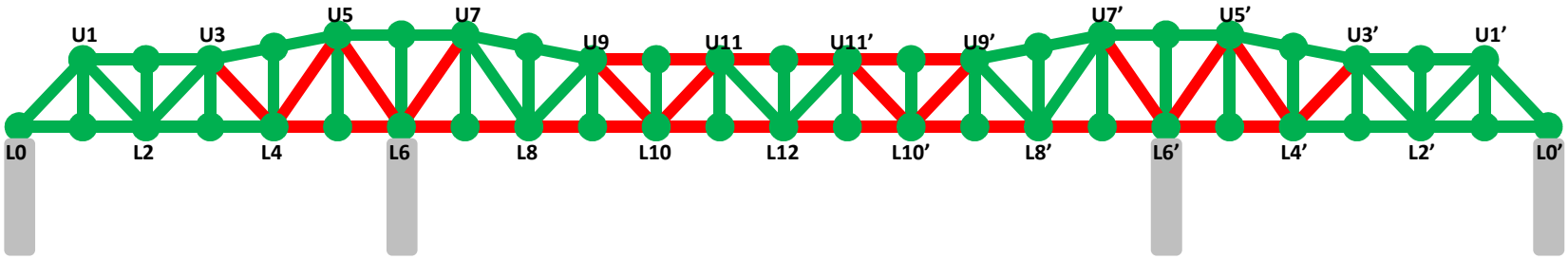
IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

ANALYSIS - 10
LIVE LOAD – HL93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



RATINGS ADEQUATE

MEMBER
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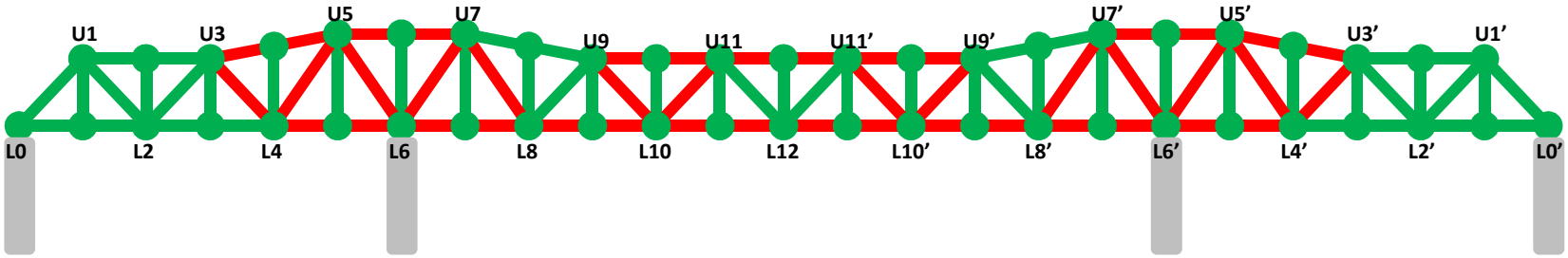
IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

ANALYSIS – 10
LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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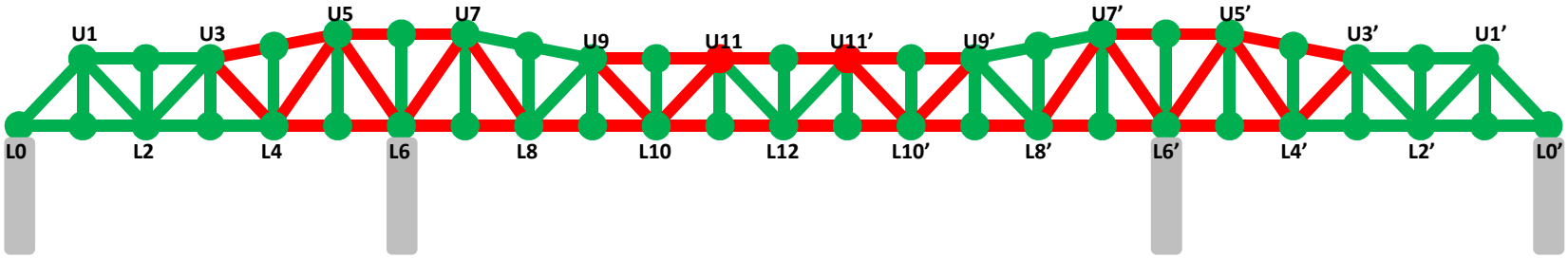
ANALYSIS – 10
LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER

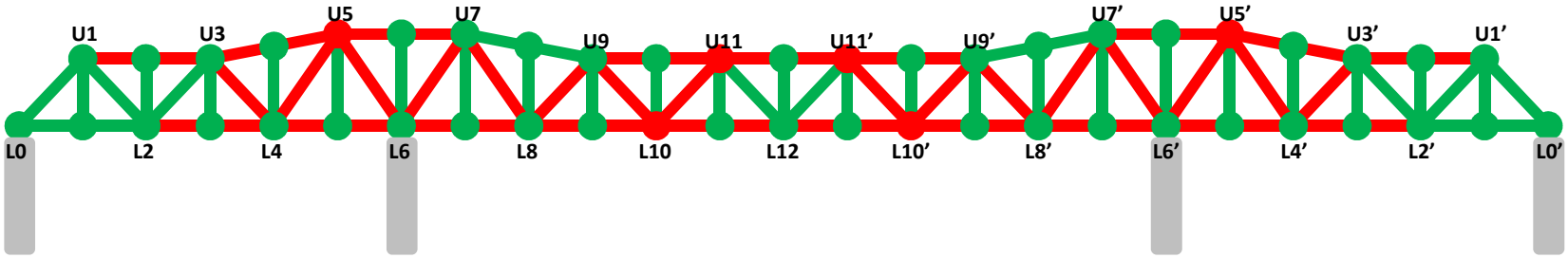
GUSSET PLATE

ANALYSIS – 10

LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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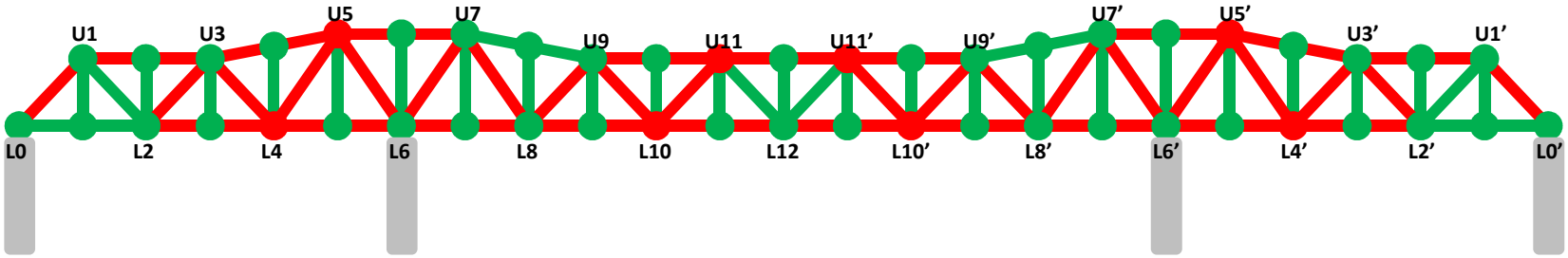
ANALYSIS – 10
LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

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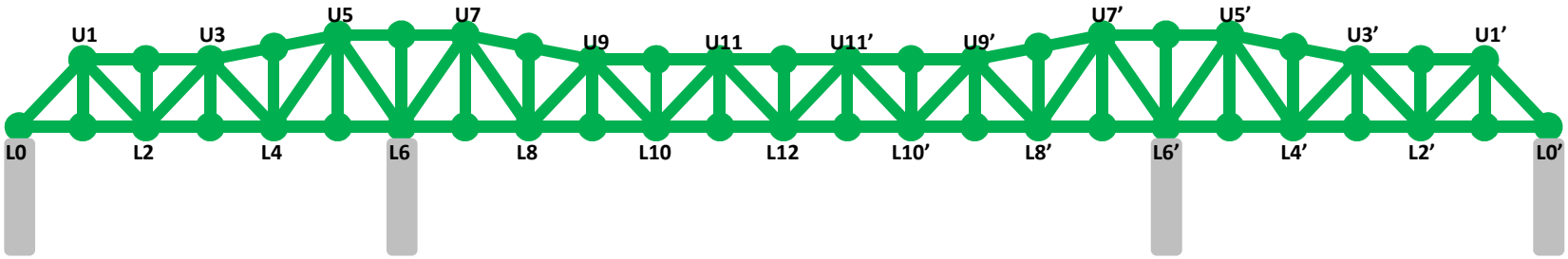
ANALYSIS – 10
LIVE LOAD – P413

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

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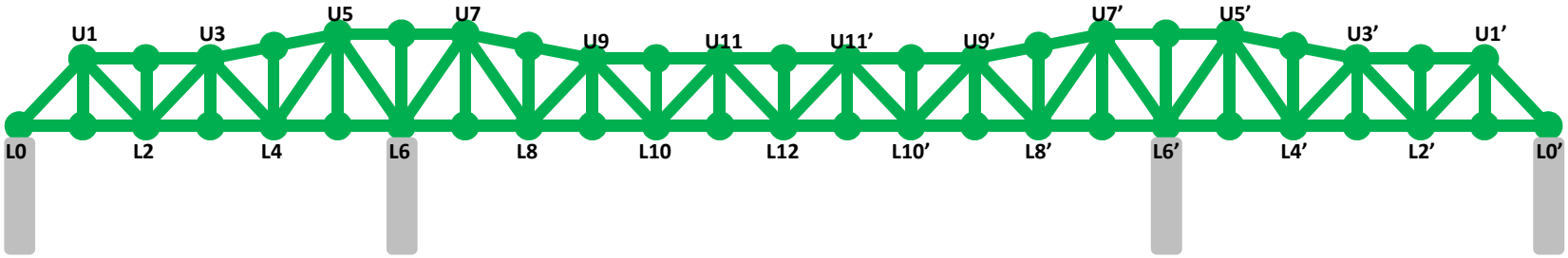
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 10A
LIVE LOAD – HS20-44

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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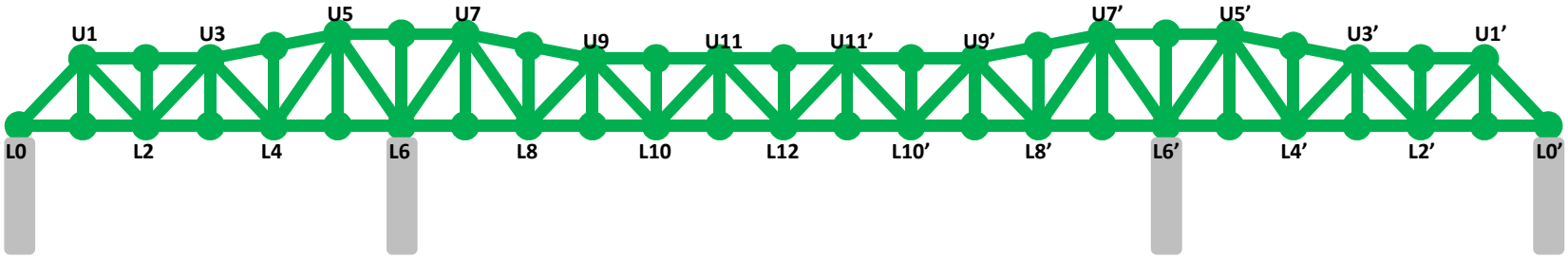
LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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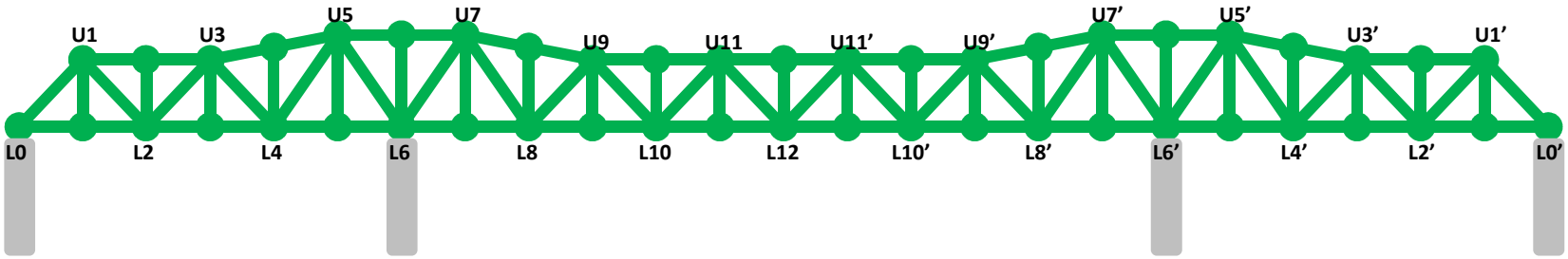
ANALYSIS – 10A
LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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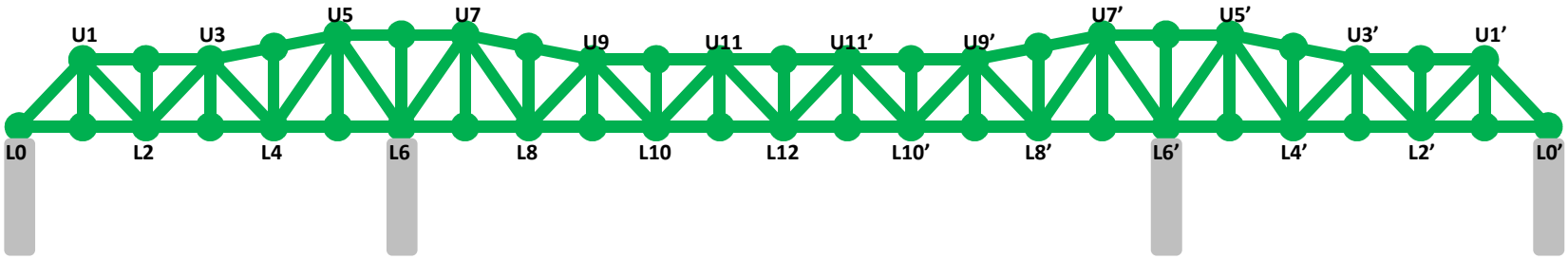
ANALYSIS – 10A
LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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MEMBER
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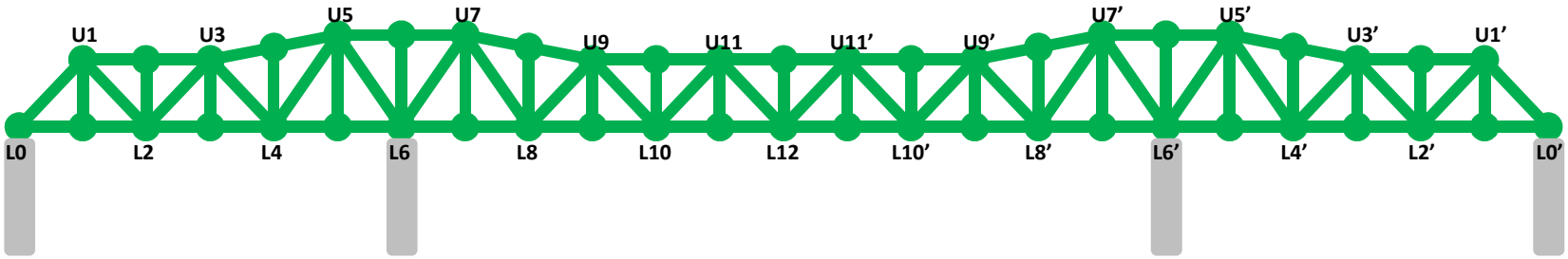
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 10A
LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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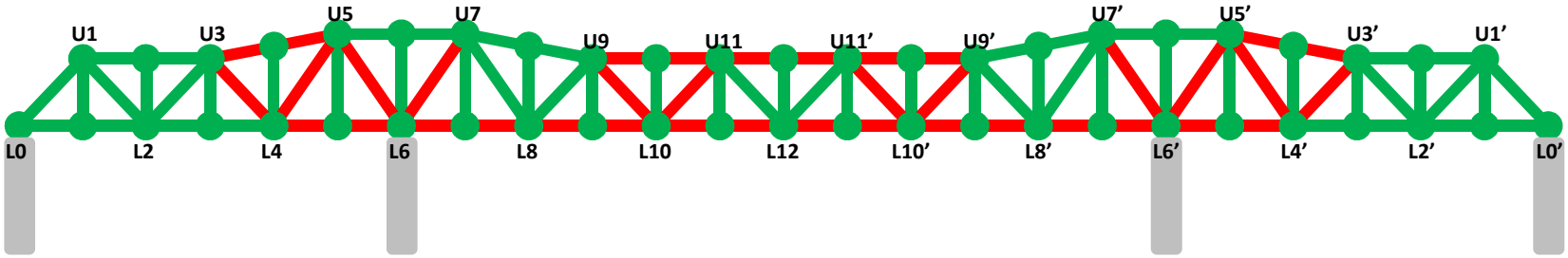
ANALYSIS – 10A
LIVE LOAD – P413

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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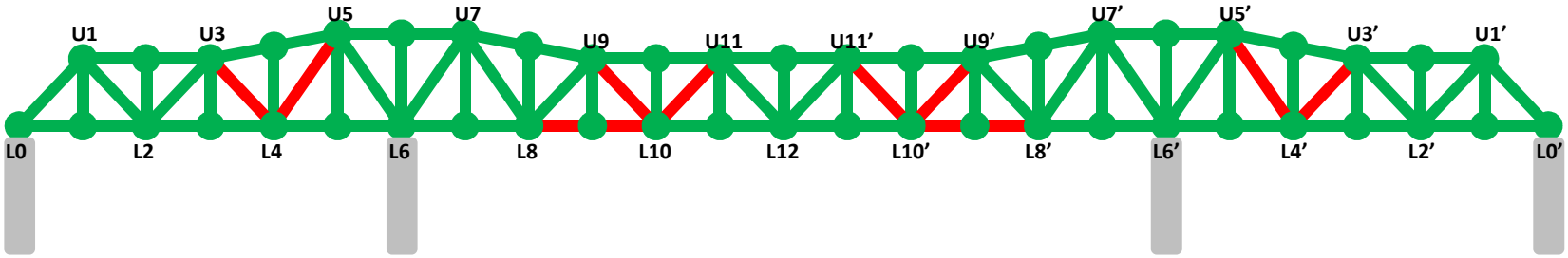
IRF < 0.90 or ORF < 1.15

MEMBER
GUSSET PLATE

ANALYSIS - 12
LIVE LOAD – HL93

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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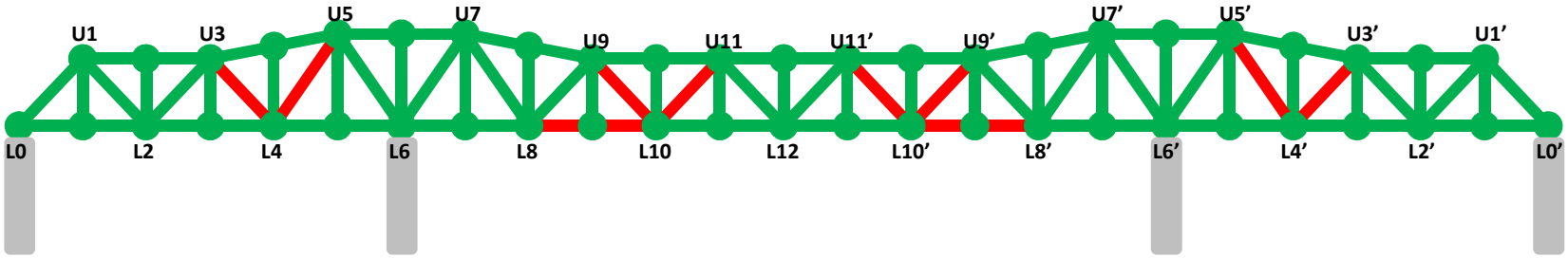
MEMBER
GUSSET PLATE

ANALYSIS – 12
LIVE LOAD – STD. A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER

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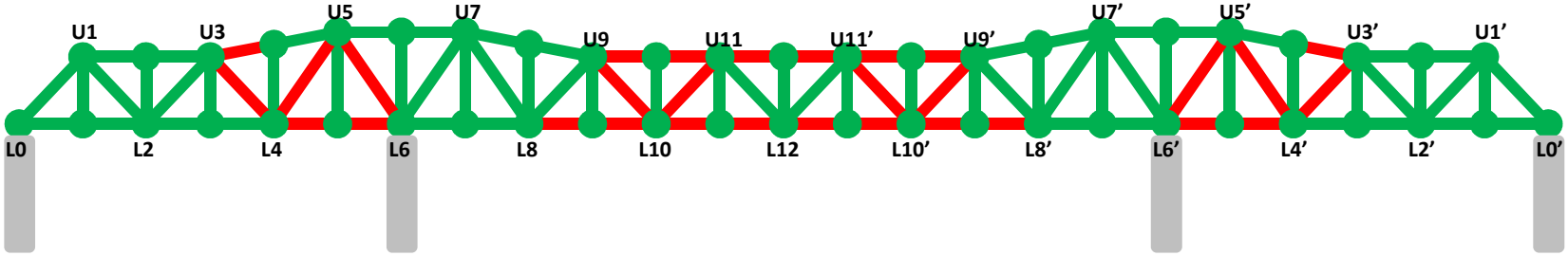
ANALYSIS – 12

LIVE LOAD – STD. B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

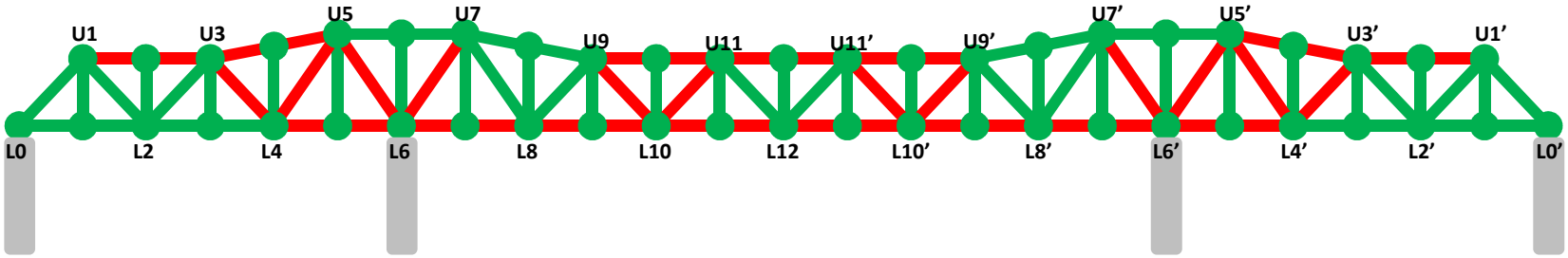
MEMBER
GUSSET PLATE

ANALYSIS – 12
LIVE LOAD – STD. C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT

RATING RESULTS



RATINGS ADEQUATE

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MEMBER

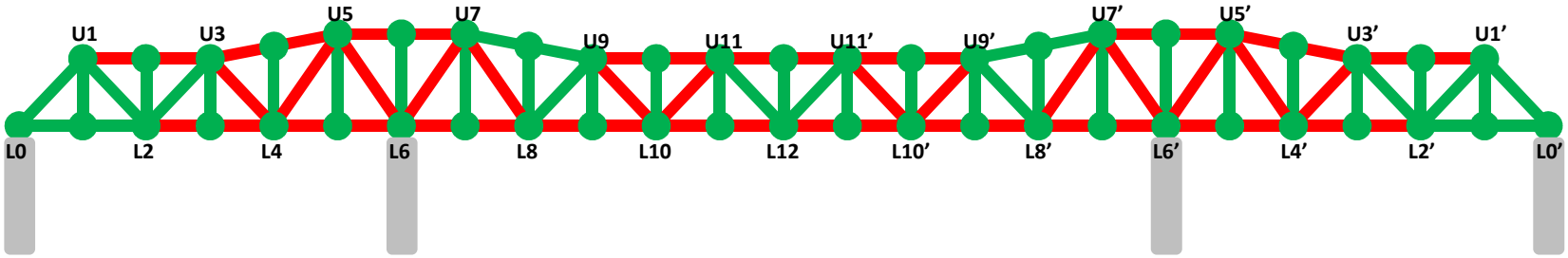
GUSSET PLATE

ANALYSIS – 12

LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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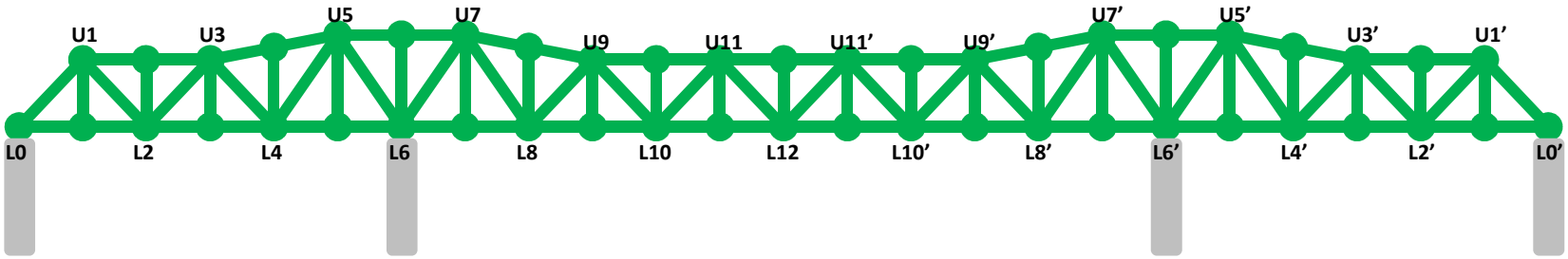
ANALYSIS – 12
LIVE LOAD – P413

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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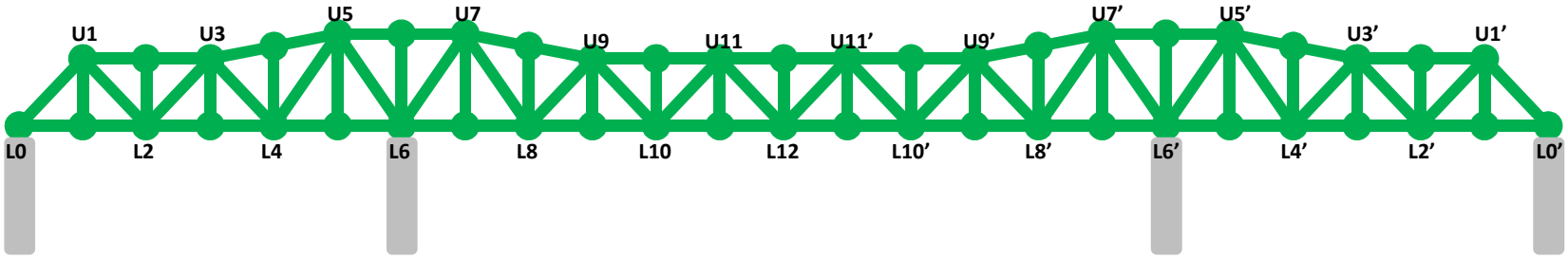
MEMBER
GUSSET PLATE

NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 12A
LIVE LOAD – HS20-44

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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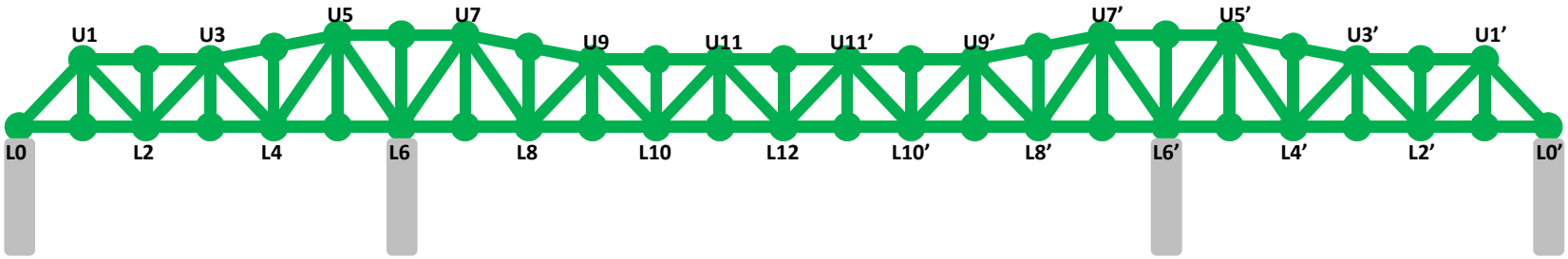
ANALYSIS – 12A
LIVE LOAD – STD A

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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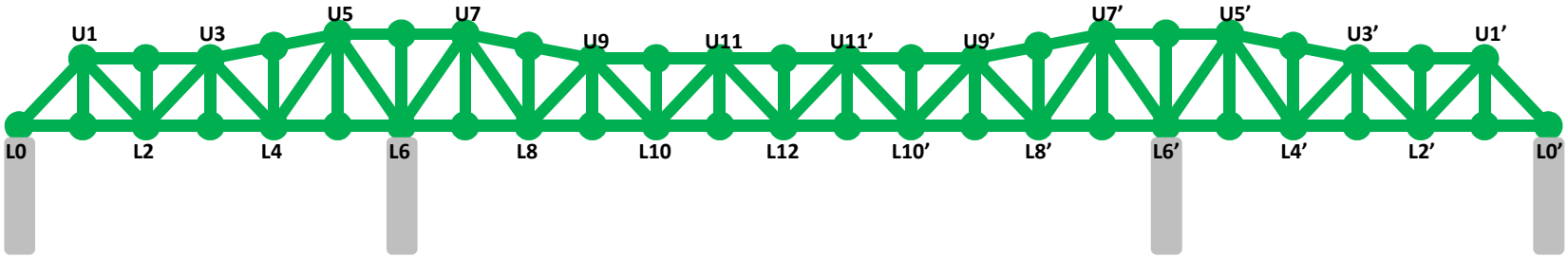
LIVE LOAD – STD B

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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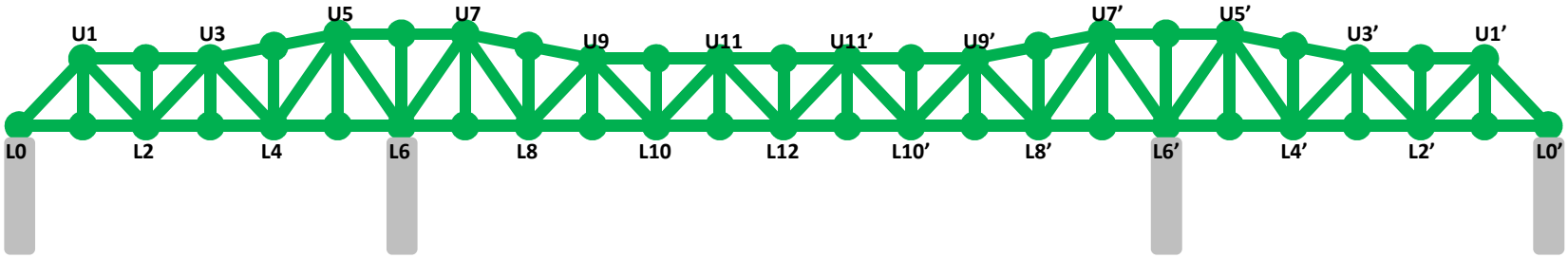
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 12A
LIVE LOAD – STD C

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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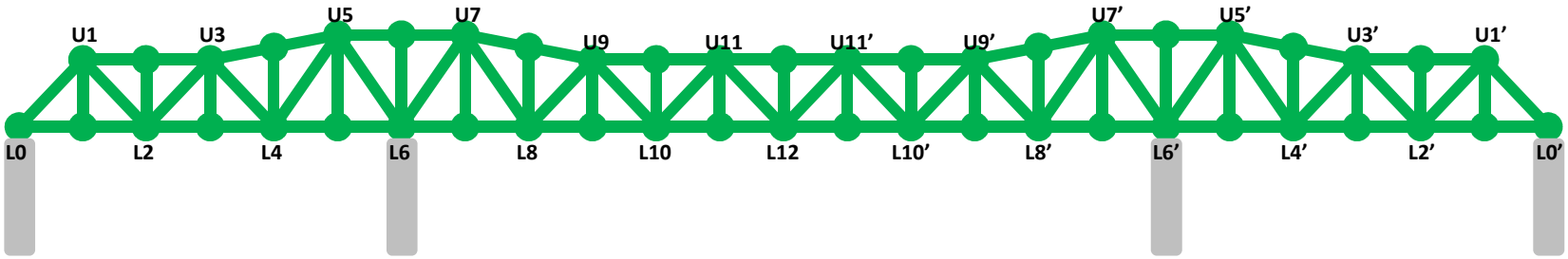
ANALYSIS – 12A
LIVE LOAD – P411

RED WING - MnDOT BRIDGE 9040

TRUSS – REPAIR RECOMMENDATION REPORT
RATING RESULTS



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IRF < 0.90 or ORF < 1.15

MEMBER
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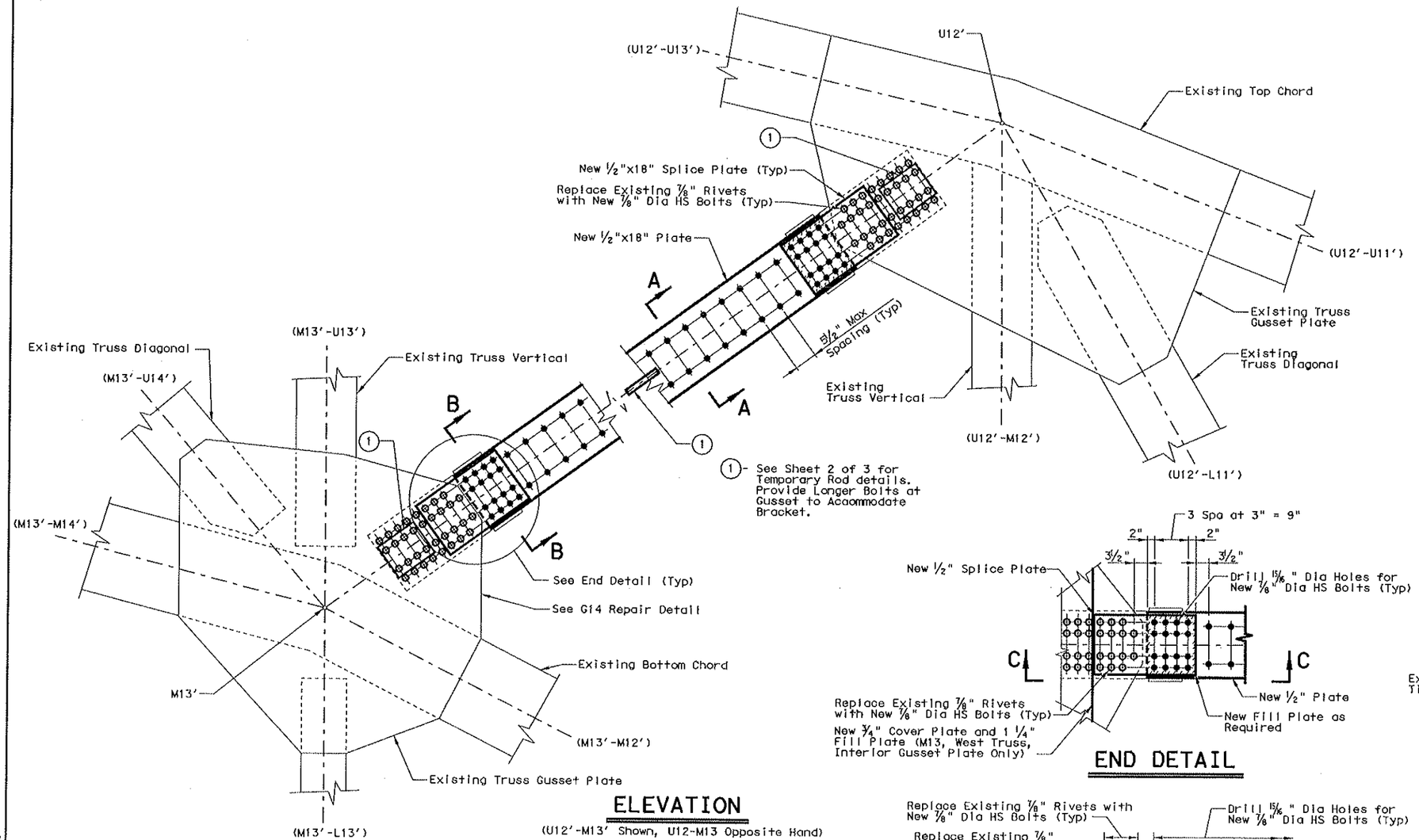
NOTE: NO ANALYSIS WAS PERFORMED FOR GUSSET PLATES, UNKNOWN IF GUSSET PLATES ARE ADEQUATE

ANALYSIS – 12A
LIVE LOAD – P413

Appendix F

Sample Retrofit Details

F1



1 - See Sheet 2 of 3 for Temporary Rod details. Provide Longer Bolts at Gusset to Accommodate Bracket.

ELEVATION

(U12'-M13' Shown, U12-M13 Opposite Hand)

REPAIR M01

(4 Locations)

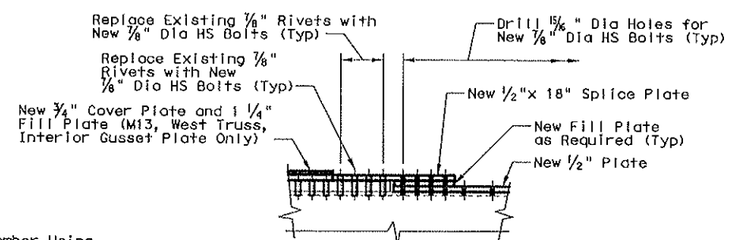
Reference Shop Drawings - 701C, 703B & 709.

REPAIR M01 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Perform G14 Repair Prior to Performing this Repair.
2. Replace All Existing 7/8 " Rivets Connecting Members U12-M13 & U12'-M13' to U12, U12', M13 & M13' Gusset Plates with New 7/8 " Dia HS Bolts as Shown. A Maximum of 4 Rivets May be Removed at Any Given Time.
3. At One Temporary Rod Tensioner Bracket Location, Remove 8 HS Bolts and Install Bracket with New Bolts. Repeat for Other 3 Locations, One at a Time.
4. Install Temporary Rods (2 Rods). Preload Each Rod to 130,000 Lbs. While Applying Preload to Rods, the Force in Each Rod Must Not Differ by More than 20,000 Lbs.
5. Drill Holes in Existing Truss Diagonal Using New Plate as a Template.
6. Install New Plates on Each Side of Member Using ⅞" Dia HS Bolts Except at New Splice Plate Locations.
7. At One Splice Location, Remove 14 HS Bolts in Gusset Plate to Install New Splice Plate.
8. Install 30 HS Bolts in New Splice Plate.
9. Repeat Steps 7 & 8 for 3 Other New Splice Plate Locations, One at a Time.
10. Remove Both Temporary Rods. When Unloading Forces in Rods, the Force in Each Rod Must Not Differ by More Than 20,000 Lbs.
11. Remove Rod Tensioner Bracket and 8 Bolts at One Location. Replace HS Bolts with New Ones.
12. Repeat Step 11 for 3 Other Tension Bracket Locations, One at a Time.

END DETAIL



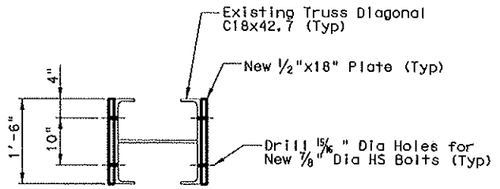
SECTION C-C

REPAIR M01 - ESTIMATED QUANTITIES

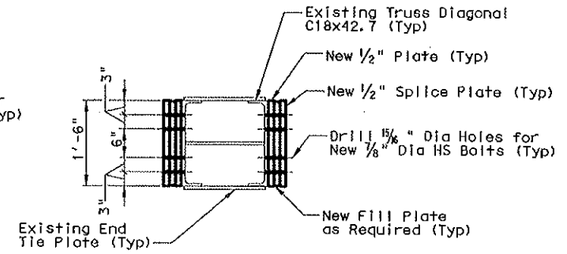
Structural Steel	2732 Lb
New ⅞" Dia High Strength Bolt	392 Bolts
New ⅞" Dia High Strength Bolt in Place of Rivet	136 Bolts
Temporary Support (Installation and Removal)	LS

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.



SECTION A-A



SECTION B-B

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheets.
3. Contractor to Submit Post-Tensioning Method, Plans and Procedure to Engineer for Review and approval.

HS20 LOADING SHEET 1 OF 3

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 28 TO 30

TRUSS MEMBER REPAIR U12 - M13 & U12' - M13'

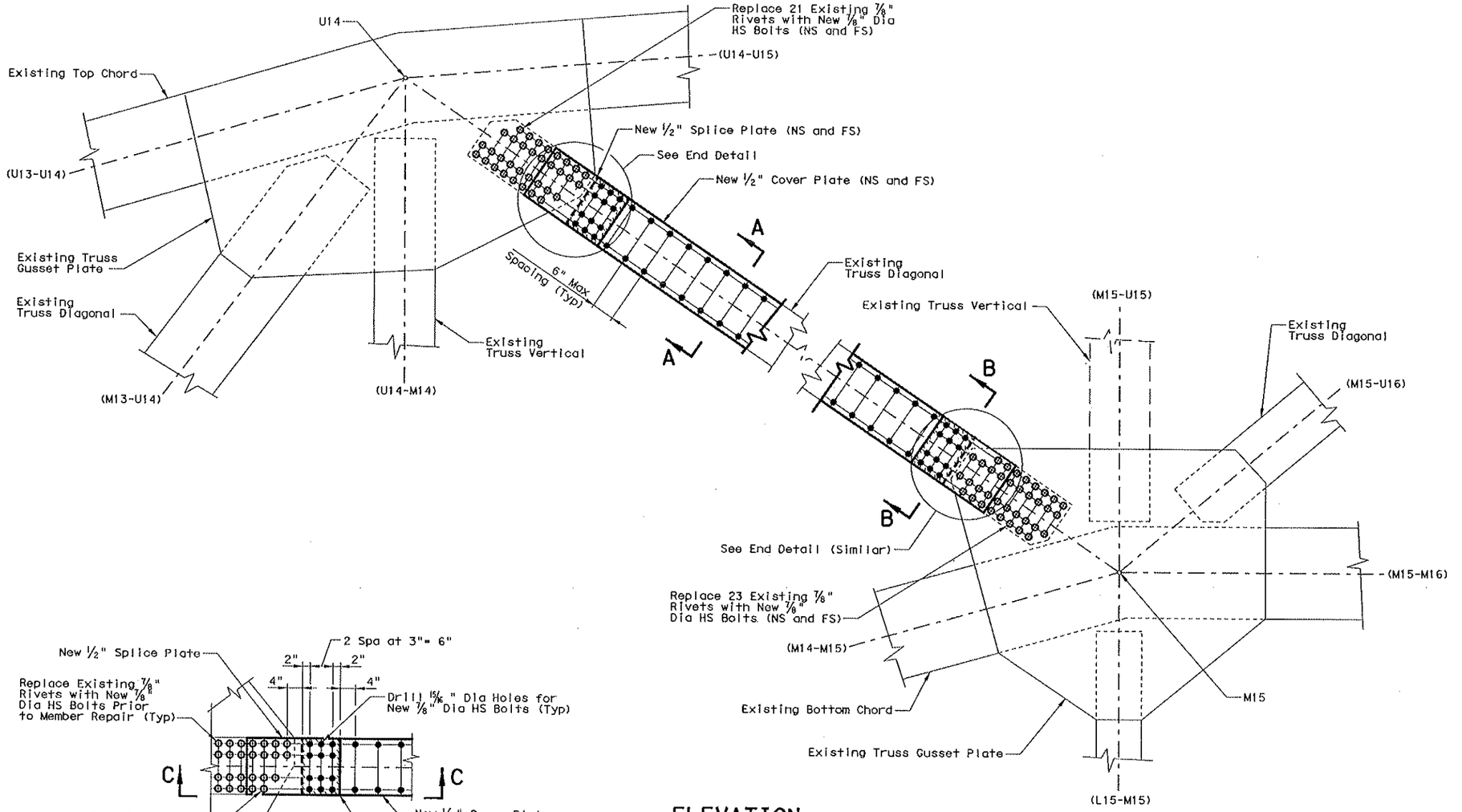
CORPUS CHRISTI HARBOR BRIDGE

FILE:	DN: SET	CK: APR	DW: SWM	CK: APR
ORIG DATE: 2009/05/08	DIST	FED REG	FEDERAL AID PROJECT NO.	SHEET
REVISIONS	CRP	6	BR 2002 (454)	119
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	NUECES		0101	06	106	US 181

0 1'-4" 2'-8" 4'-0" 5'-4"
SCALE IN FEET

STATE OF TEXAS
PATRICK M. BACHMAN
60672
REGISTERED PROFESSIONAL ENGINEER
9-24-09

F2



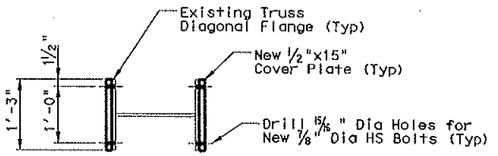
ELEVATION

REPAIR M03 - ESTIMATED QUANTITIES

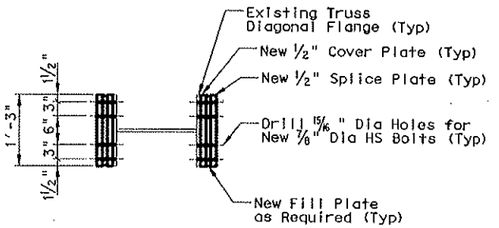
Structural Steel	2190 Lb
New 7/8" Dia High Strength Bolt	344 Bolts
New 7/8" Dia High Strength Bolt in Place of Rivet	140 Bolts

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.



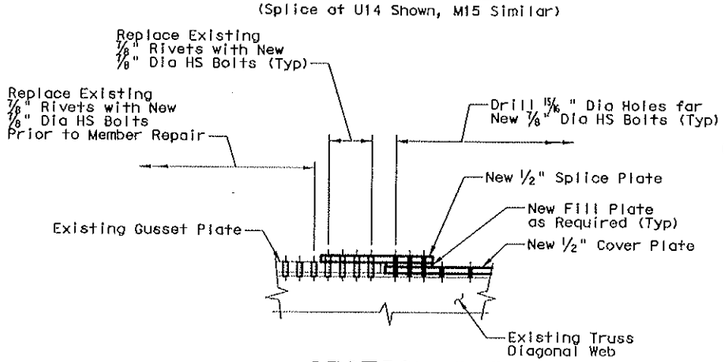
SECTION A-A



SECTION B-B

END DETAIL

(Splice at U14 Shown, M15 Similar)



SECTION C-C

REPAIR M03

(1 Location)

Reference Shop Drawings - 702C, 902B & 905.

REPAIR M03 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Replace 21 Existing 7/8" Rivets in U14 Gusset Plate and 23 in M15 Gusset Plate with New 7/8" Dia HS Bolts at Locations Shown. A Maximum of 4 Rivets May be Removed at Any Given Time.
2. Drill New Holes in Truss Diagonal Flanges Using New Plate as a Template. Drill Holes in New Splice Plate to Match Existing Hole Layout.
3. Remove Existing 7/8" Dia Rivets in Gusset Plates at Splice Plate Locations as Shown.
4. Install New Cover, Fill and Splice Plates and 7/8" Dia HS Bolts.

0 1'-4" 2'-8" 4'-0" 5'-4"

SCALE IN FEET

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheet.

HS20 LOADING SHEET 1 OF 1

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 28 TO 30

TRUSS MEMBER REPAIR

U14 - M15

CORPUS CHRISTI HARBOR BRIDGE

FILE:	DN: SET	CK: APR	DW: SRM	CK: APR	
ORIG DATE: 2009/06/03	DIST	FED REG	FEDERAL AID PROJECT NO.		SHEET
REVISIONS	CRP	6	BR 2002 (454)		124
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	NUECES		0101	06	106	US 181

STATE OF TEXAS
PATRICK M. BACHMAN
60672
REGISTERED
PROFESSIONAL ENGINEER
09-24-09

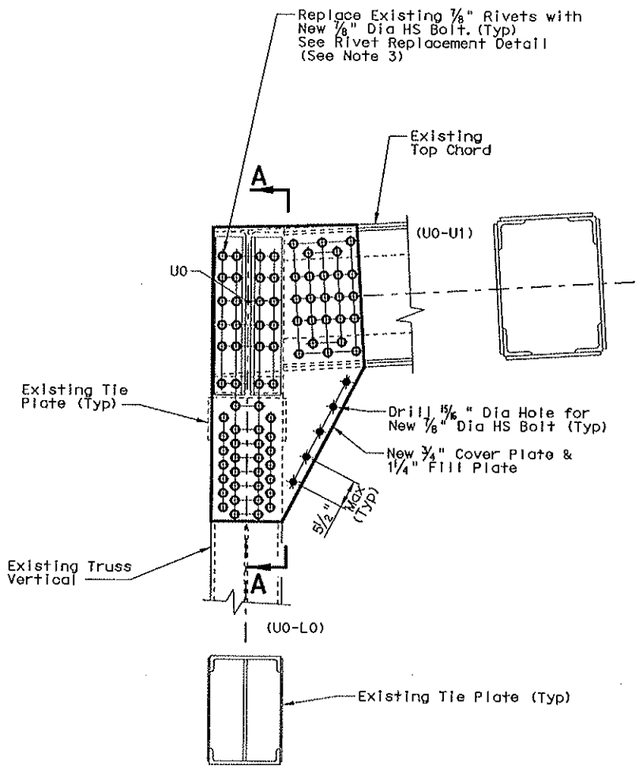
FILE: C:\P\Working\DAL\dms95420\CCHBTRSREP03.dgn
DATE: 9/24/2009 TIME: 3:00:25 PM USER: SUSERS

REPAIR G11 - ESTIMATED QUANTITIES

Structural Steel	980 Lb
New 7/8" Dia High Strength Bolt	5 Bolts
New 7/8" Dia High Strength Bolt in Place of Rivet	79 Bolts

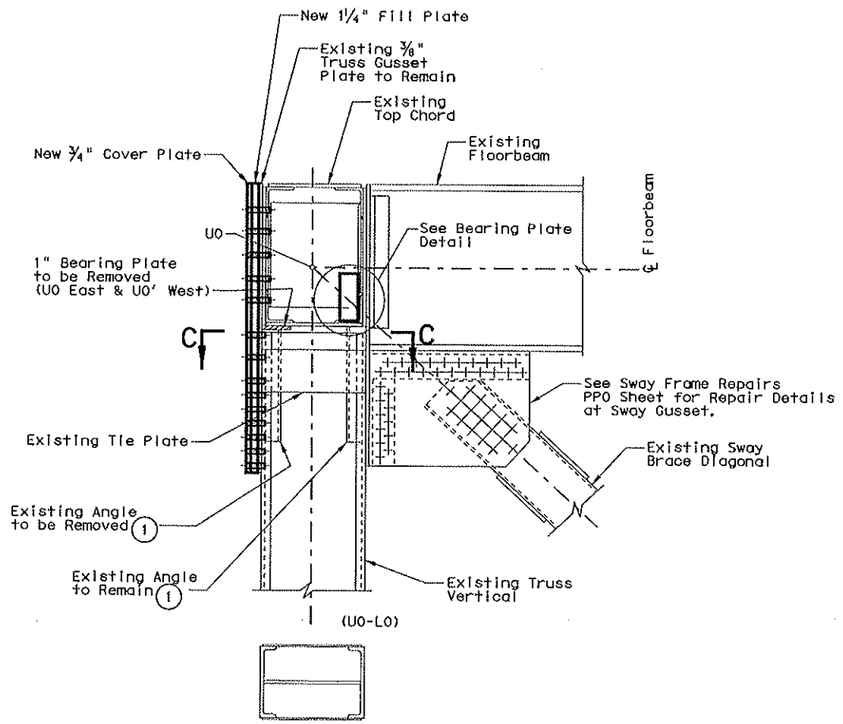
Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.



ELEVATION

(U0 Shown, U0' Similar)
(Eost Truss Shown, West Truss Similar)



SECTION A-A

(Lateral Bracing Not Shown for Clarity)

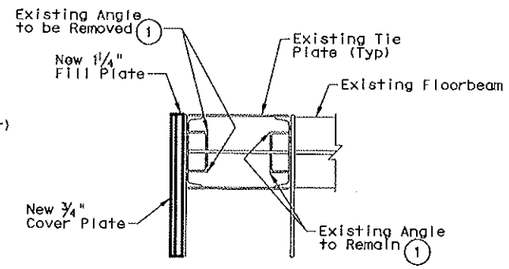
REPAIR G11

(4 Locations)
Reference Shop Drawings 101 & 108.

REPAIR G11 - PROCEDURE

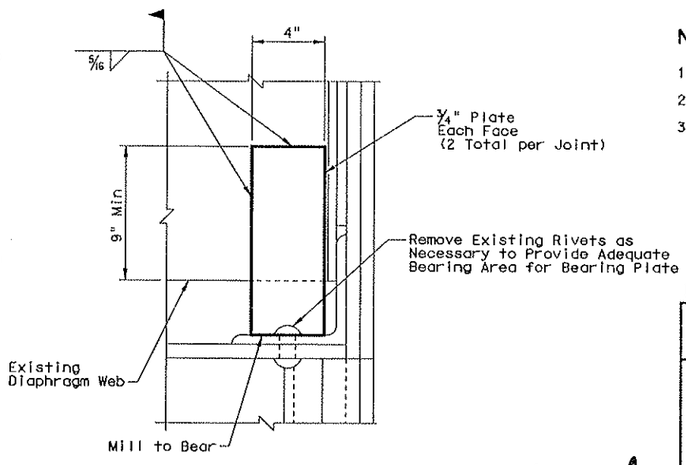
(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Drill Holes in New Fill Plate and New Cover Plate to Match Existing Hole Layout.
2. Install New Plates per Bearing Plate Detail.
3. Remove Existing Angles as Shown to Allow Rivet Replacement. Grind Welds Smooth on Truss Members.
4. Replace Individual Rivets with New HS Bolts. A Maximum of 4 Rivets May be Removed at Any Given Time.
5. Install New Fill Plate and New Cover Plate. Install Second Nut on HS Bolts.
6. Drill Holes and Install New HS Bolts as Shown Around Perimeter of New Cover Plate.



SECTION C-C

(1) L4x4x3/8 at U0 East & U0' West.
L5x3x3/8 at U0 West & U0' East.



BEARING PLATE DETAIL

0 1'-4" 2'-8" 4'-0" 5'-4"
SCALE IN FEET

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheets.
3. For Rivet Replacement Detail, See "Repair Details Spans 28 to 30, Sway Frame Repairs, Miscellaneous Details".

HS20 LOADING SHEET 1 OF 1

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 28 TO 30

TRUSS GUSSET PLATE REPAIR - U0 & U0'

CORPUS CHRISTI HARBOR BRIDGE

STATE OF TEXAS
PATRICK M. BACHMAN
60672
REGISTERED PROFESSIONAL ENGINEER
9-24-09

FILE:	DN: APR	CK: SET	DN: SMM	CK: APR
ORIG DATE: 2009/05/08	DIST	FED REG	FEDERAL AID PROJECT NO.	SHEET
REVISIONS	CRP	6	BR 2002 (454)	125
	COUNTY	CONTROL	SECT	JOB	HIGHWAY
	NUECES	0101	06	106	US 181

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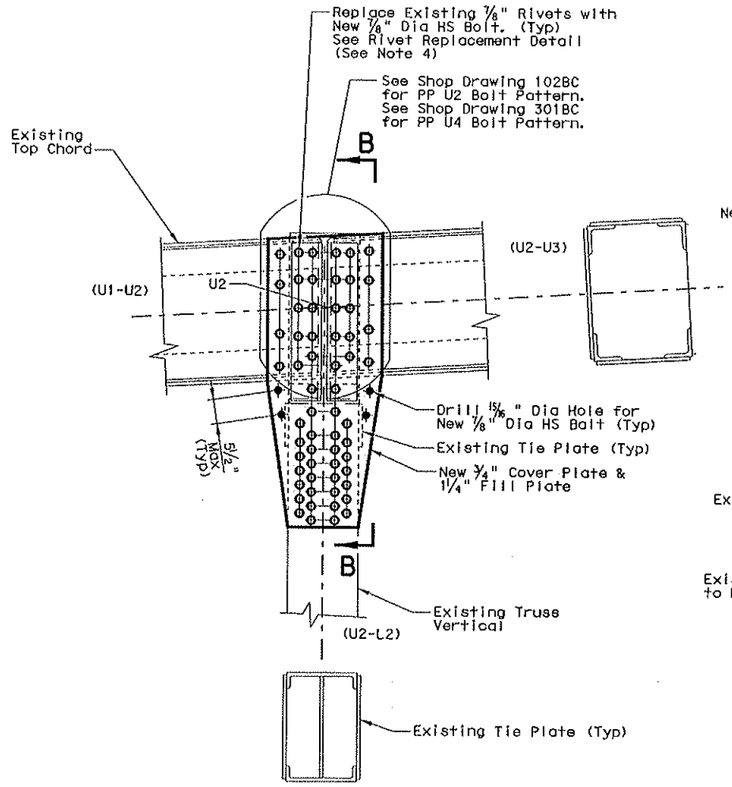
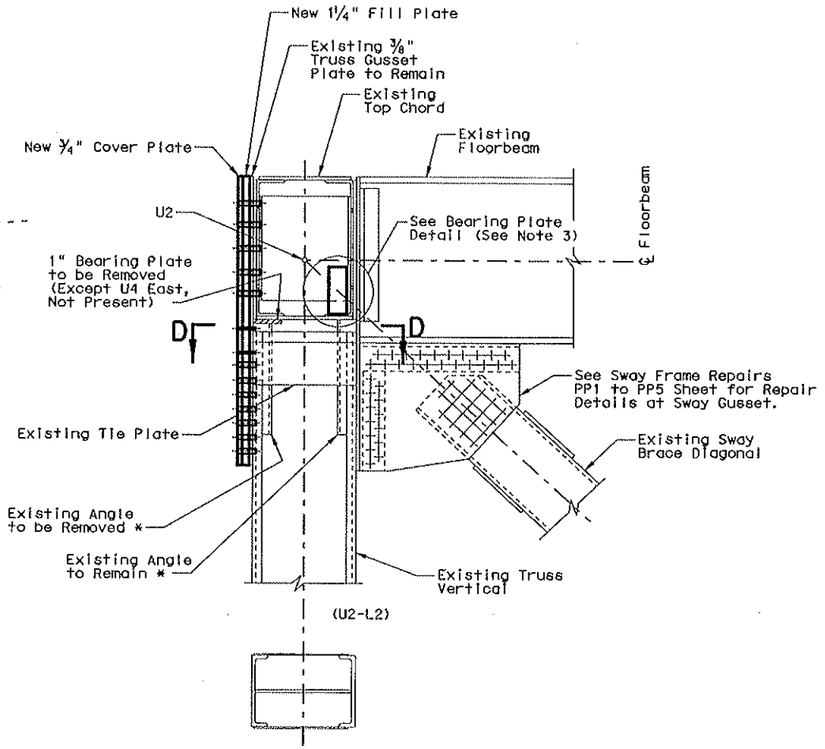


ELEVATION

(U2 Shown, U2', U4 & U4' Similar)
(East Truss Shown, West Truss Similar)



SECTION B-B

(Lateral Bracing Not Shown for Clarity)

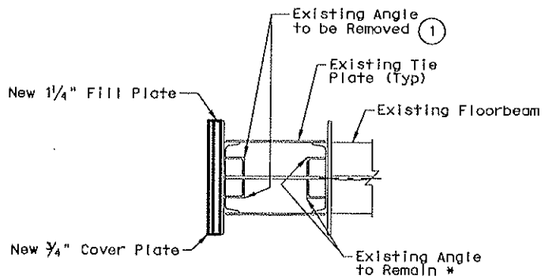
REPAIR G12

(8 Locations)
Reference Shop Drawings - 102BC, 107, 301BC & 308.

REPAIR G12 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Drill Holes in New Fill Plate and New Cover Plate to Match Existing Hole Layout.
2. Install New Plates per Bearing Plate Detail.
3. Remove Existing Angles as Shown to Allow Rivet Replacement. Grind Welds Smooth on Truss Members.
4. Replace Individual Rivets with New HS Bolts. A Maximum of 4 Rivets May be Removed at Any Given Time.
5. Install New Fill Plate and New Cover Plate. Install Second Nut on HS Bolts.
6. Drill Holes and Install New HS Bolts as Shown Around Perimeter of New Cover Plate.



SECTION D-D

(1) L5x3x3/8 at U4 East.
L4x4x3/8 at All Other Locations.

REPAIR G12 - ESTIMATED QUANTITIES

Structural Steel ..... 784 Lb
New 7/8" Dia A325 High Strength Bolt ..... 4 Bolts
New 7/8" Dia A325 High Strength Bolt in Place of Rivet ..... 60 Bolts

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheets.
3. For Bearing Plate Detail, See "Repair Details Spans 28 to 30 Truss Gusset Plate Repair - U0".
4. For Rivet Replacement Detail, See "Repair Details Spans 28 to 30, Sway Frame Repairs, Miscellaneous Details".

HS20 LOADING SHEET 1 OF 1

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 28 TO 30

TRUSS GUSSET PLATE REPAIR-U2, U4, U2' & U4'

CORPUS CHRISTI HARBOR BRIDGE

FILE:	DN: APR	CK: SET	DN: SRM	CK: APR			
ORIG DATE: 2009/06/10	DIST	FED REG	FEDERAL AID PROJECT NO.				SHEET
REVISIONS	CRP	6	BR 2002 (454)				126
	COUNTY			CONTROL	SECT	JOB	HIGHWAY
	NUECES			0101	06	106	US 181

0 1'-4" 2'-8" 4'-0" 5'-4"
SCALE IN FEET

STATE OF TEXAS
PATRICK M. BACHMAN
60672
REGISTERED PROFESSIONAL ENGINEER
9-24-09

FILE: C:\PWworking\DAL\dms95420\CCHBBGUSREP03A.dgn
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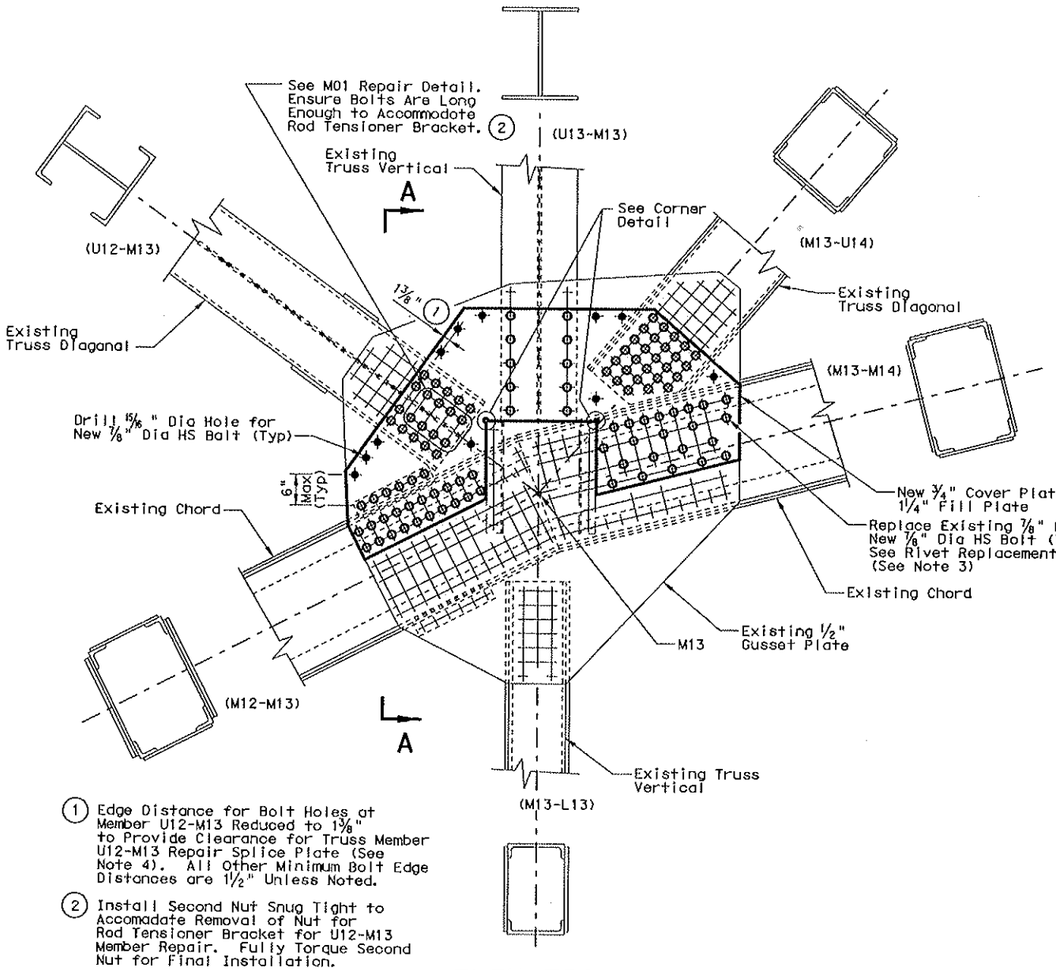
F5



(1) Edge Distance for Bolt Holes at Member U12-M13 Reduced to 1⅜" to Provide Clearance for Truss Member U12-M13 Repair Splice Plate (See Note 4). All Other Minimum Bolt Edge Distances are 1½" Unless Noted.

(2) Install Second Nut Snug Tight to Accomadate Removal of Nut for Rod Tensioner Bracket for U12-M13 Member Repair. Fully Torque Second Nut for Final Installation.

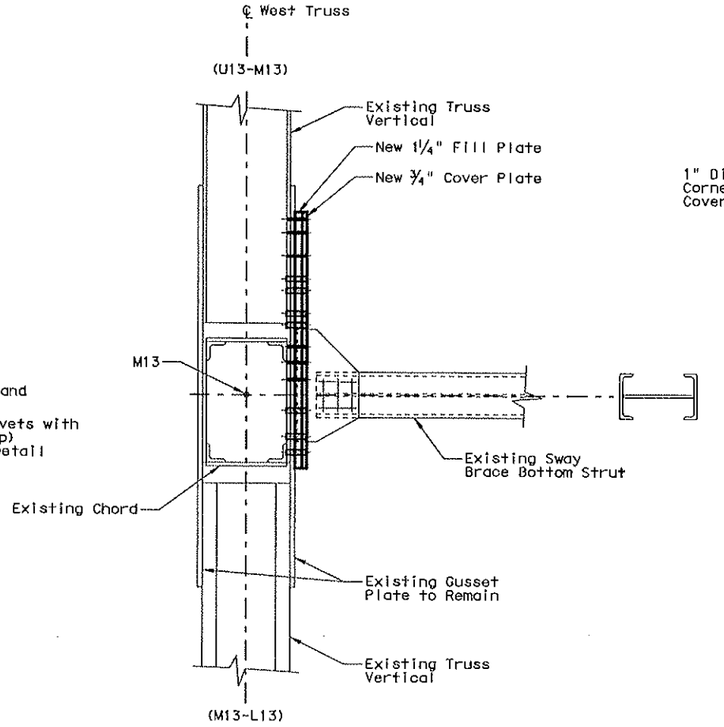
ELEVATION

(West Truss, Interior Gusset Plate)

REPAIR G14

(1 Location)

Reference Shop Drawings - 703B, 709, 710, 713, 755 & 902AB.



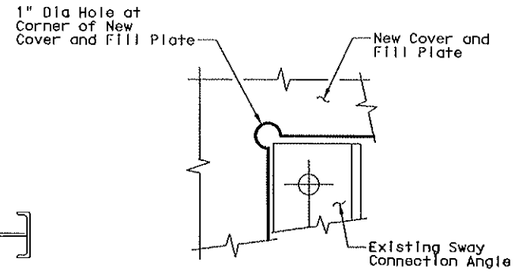
SECTION A-A

REPAIR G14 - ESTIMATED QUANTITIES

Structural Steel	1391 Lb
New 7/8" Dia High Strength Bolt	11 Bolts
New 7/8" Dia High Strength Bolt in Ploce of Rivet	105 Bolts

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.



CORNER DETAIL

(Left Corner Shown, Right Corner Opposite Hand)

NTS

REPAIR G14 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Drill Holes in New Fill Plate and New Cover Plate to Match Existing Rivet Layout.
2. Replace Individual Rivets with New HS Bolts at Locations Shown. A Maximum of 4 Rivets May be Removed at Any Given Time.
3. Install New Fill Plate and New Cover Plate. Install Second Nut on HS Bolts. Install Second Nut Snug Tight in Region of Rod Tensioner Bracket.
4. Drill Holes and Install New HS Bolts as Shown Around Perimeter of New Cover Plate.

0 1'-4" 2'-8" 4'-0" 5'-4"

SCALE IN FEET

STATE OF TEXAS
PATRICK M. BACHMAN
60672
REGISTERED PROFESSIONAL ENGINEER
9-24-09

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheets.
3. For Rivet Replacement Detail, See "Repair Details Spans 28 to 30, Sway Frame Repairs, Miscellaneous Details".
4. Coordinate Repair with U12-M13 Truss Member Repair. See "Repair Details Spans 28 to 30, Truss Member Repair, U12-M13 & U12'-M13' ", Sheets 1 to 3.

HS20 LOADING SHEET 1 OF 1

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 28 TO 30

TRUSS GUSSET PLATE REPAIR - M13

CORPUS CHRISTI HARBOR BRIDGE

FILE:	DN: APR	CK: SET	DW: SNM	CK: APR	
ORIG DATE: 2009/05/08	DIST	FED RCG	FEDERAL AID PROJECT NO.		SHEET
REVISIONS	CRP	6	BR 2002 (454)		128
	COUNTY		CONTROL	SECT	JOB	HIGHWAY
	NUECES		0101	06	106	US 181

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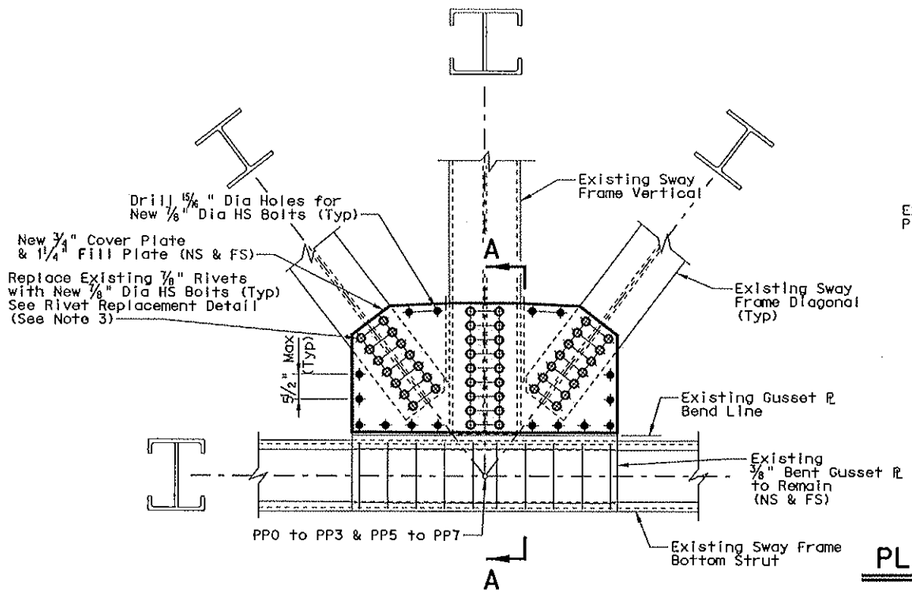
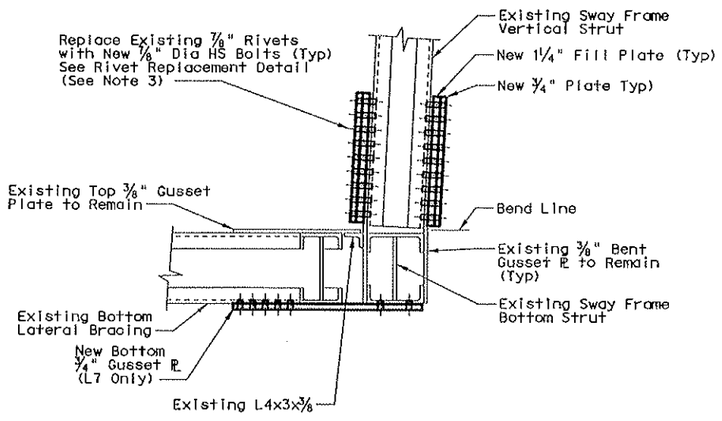


ELEVATION

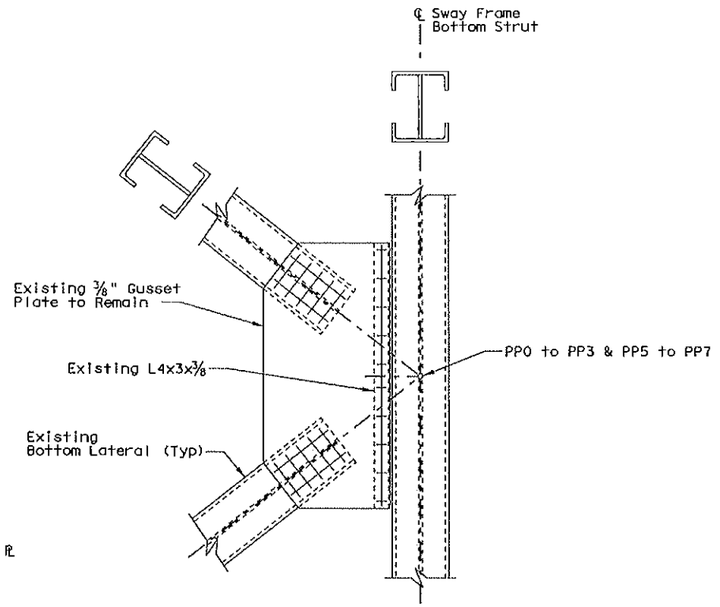
REPAIR G03

(14 Locations - 2 Sides per Location)
(Span 27 Shown, Span 31 Similar)

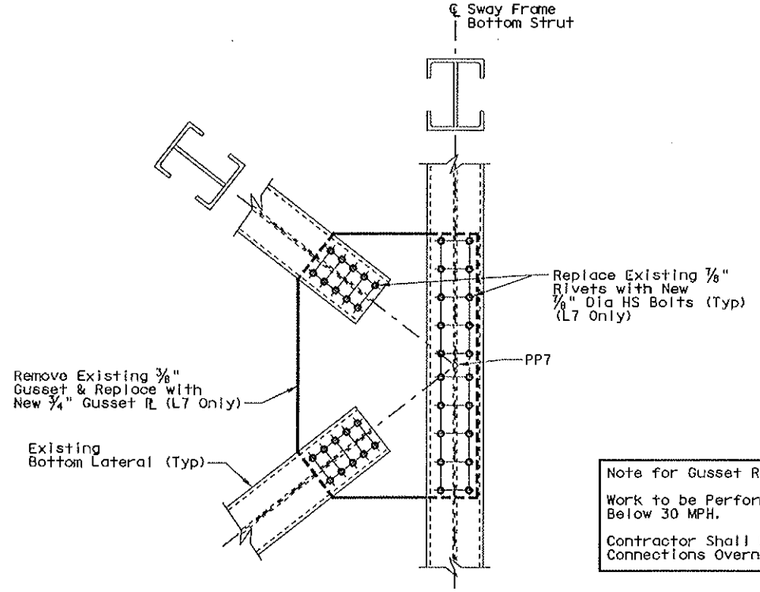


SECTION A-A

(L7, L6, L5 As Shown,
L3, L2, L1 Lateral Bracing Opposite Hand)



PLAN - BOTTOM LATERAL TOP GUSSET PLATE



PLAN - BOTTOM LATERAL BOTTOM GUSSET PLATE

REPAIR G04

(2 Locations - New Plate at L7 Only)

Note for Gusset Replacement:

Work to be Performed with Wind Below 30 MPH.

Contractor Shall Not Leave Uncompleted Connections Overnight.

REPAIR G03 - ESTIMATED QUANTITIES

Structural Steel ..... 1664 Lb

New 7/8" Dia High Strength Bolt ..... 32 Bolts

New 7/8" Dia High Strength Bolt in Place of Rivet ..... 92 Bolts

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.

REPAIR G04 - ESTIMATED QUANTITIES

Structural Steel ..... 437 Lb

New 7/8" Dia A325 High Strength Bolt in Place of Rivet ..... 40 Bolts

Notes: Estimated Quantities Are per Location.

Quantities Are for Contractor's Information Only and Are Subsidiary to the Estimate Summary Bid Item.

REPAIR G03 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Drill Holes in New Fill and Cover Plates to Match Existing Hole Layout.
2. Replace Individual Rivets with New HS Bolts. A Maximum of 4 Rivets May be Removed at Any Given Time.
3. Install New Fill and Cover Plate. Install Second Nut on HS Bolts.
4. Drill Holes and Install New HS Bolts as Shown Around Perimeter of New Cover Plate.
5. Repeat Steps 2 through 4 for the Other New Cover Plate. Step 2 May be Completed for Both Cover Plates Before Continuing to Step 3.

REPAIR G04 - PROCEDURE

(For Structural Steel Surface Preparation Procedure, See "Bridge Notes" Sheet)

1. Drill Holes in New Gusset Plate to Match Existing Hole Layout.
2. Remove Rivets Attaching Bottom Lateral Gusset Plate to Bottom Strut & Lateral Bracing.
3. Remove Existing Gusset Plate.
4. Install New Gusset Plate Using New HS Bolts in Existing Rivet Holes.

NOTES:

1. See "Bridge Notes" Sheet.
2. See "Truss Repair Locations" Sheets.
3. For Rivet Replacement Detail, See "Repair Details Spans 28 to 30, Sway Frame Repairs, Miscellaneous Details".

SWAY FRAME AND BOTTOM LATERAL GUSSET PLATE REPAIR - L0 TO L3 & L5 TO L7

Reference Shop Drawings - 110, 210, 211, 306 & 412.

0 1'-4" 2'-8" 4'-0" 5'-4"
SCALE IN FEET

HS20 LOADING SHEET 1 OF 2

HDR Engineering, Inc.
4401 West Gate Blvd, Suite 400
Austin, Texas 78745 (Firm #754)

Texas Department of Transportation

REPAIR DETAILS SPANS 27 & 31

SWAY FRAME GUSSET PLATE REPAIR

CORPUS CHRISTI HARBOR BRIDGE

PATRICK M. BACHMAN
60672
REGISTERED PROFESSIONAL ENGINEER
STATE OF TEXAS
9-24-09

FILE:	DN: APR	CK: CMR	DW: SWM	CK: APR
ORIG DATE: 2009/05/07	DIST	FED REG	FEDERAL AID PROJECT NO.	SHEET
REVISIONS	CRP	6	BR 2002 (454)	115
	COUNTY		CONTROL SECT JOB	HIGHWAY
	NUECES		0101 06 106	US 181

FILE: C:\PWworking\DAL\dms95420\CCHBBGUSREP02.dgn
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F7

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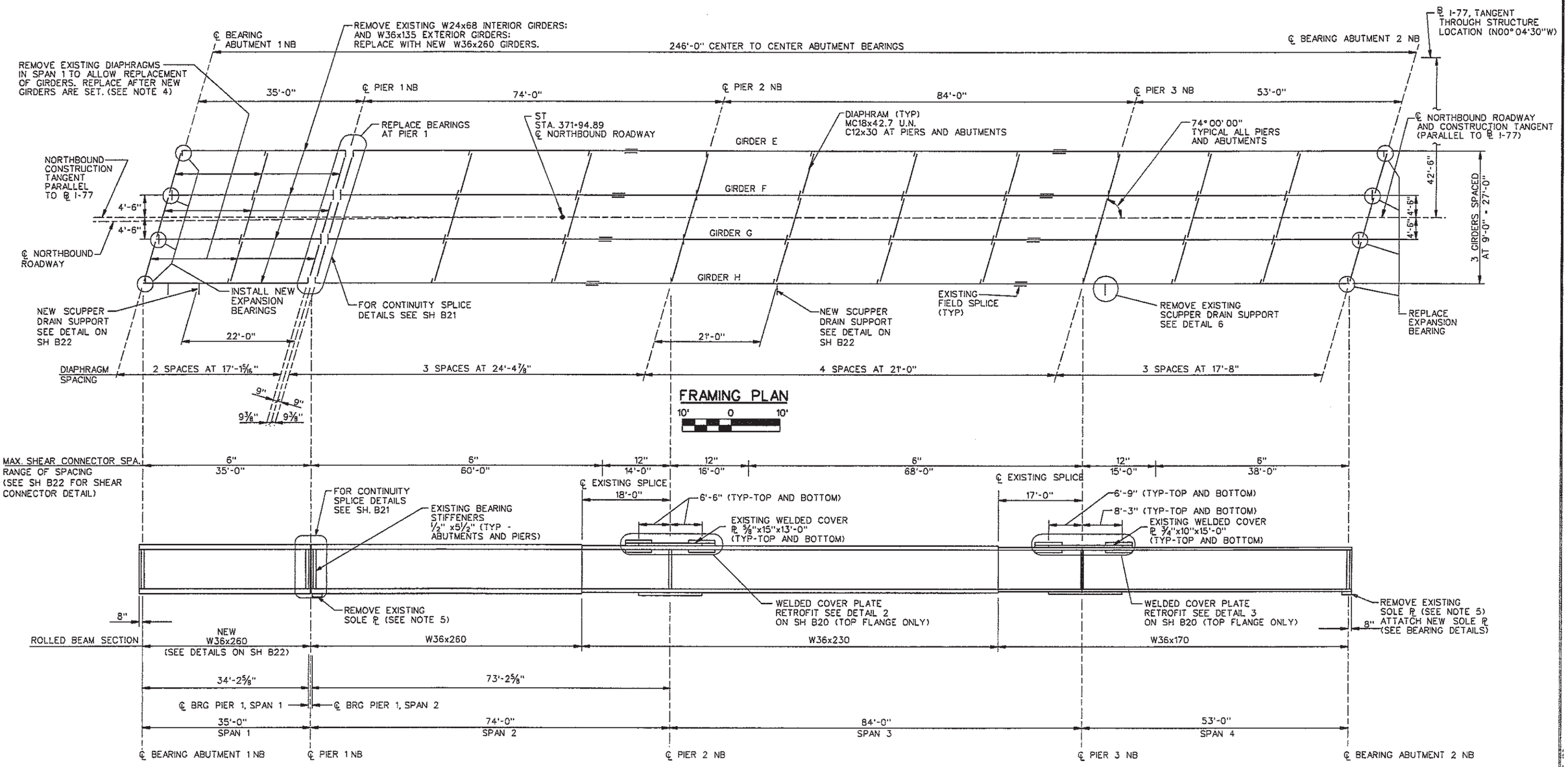


GIRDER ELEVATION

10' 0 10'

NOTES:

1. FOR GENERAL NOTES, SEE SH. B3 & B4.
2. FOR STEEL DETAILS, SEE SH. B20 THROUGH B22.
3. FOR BEARING DETAILS, SEE SH. B25 & B26.
4. CONTRACTOR SHALL PROVIDE TEMPORARY SUPPORT TO ENSURE STABILITY OF EXISTING SPAN 1 GIRDERS WHILE DIAPHRAGMS AND GIRDERS ARE REMOVED, AND NEW GIRDERS ARE SHIPPED, HANDLED AND ERECTED PRIOR TO REINSTALLATION OF DIAPHRAGMS
5. WHERE EXISTING SOLE PL'S ARE REMOVED, GRIND WELDS SMOOTH AND PAINT AS SPECIFIED IN THE GENERAL NOTES.
6. ADJUST SHEAR STUD SPACING AS REQUIRED TO AVOID BOLTS IN SPLICES AND COVER PLATE RETROFITS.
7. FOR PURPOSE OF REMOVAL OF UNAUTHORIZED WELDS ON EXISTING TOP FLANGES (SEE GENERAL NOTES), ENTIRE LENGTH OF TOP FLANGE SHALL BE CONSIDERED IN TENSION OR REVERSAL.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

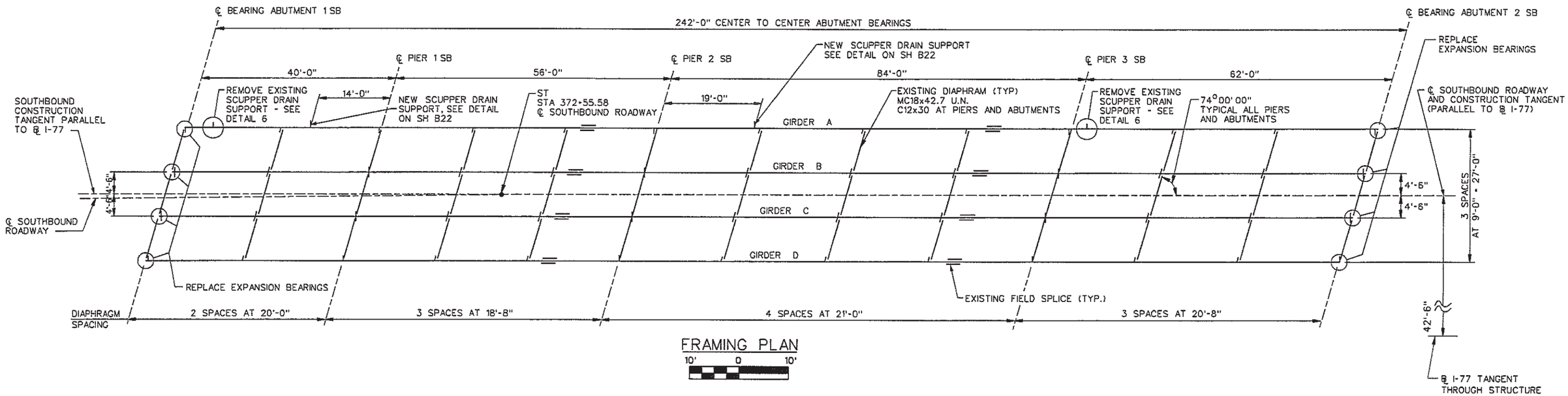
I-77 OVER I-77 RAMP H
ROCKY HOLLOW BRIDGES
NORTHBOUND FRAMING PLAN AND GIRDER ELEVATION

HDR ENGINEERING, INC.
CONSULTING ENGINEERS
WEIRTON, WV (304) 723-1010

DESIGNED JWB	DATE 7-99	CHECKED MAB	DATE 7-99	BRIDGE NO.	2432
DRAWN TMD	DATE 7-99	CHECKED MAB	DATE 7-99	SHEET NO.	B18 OF

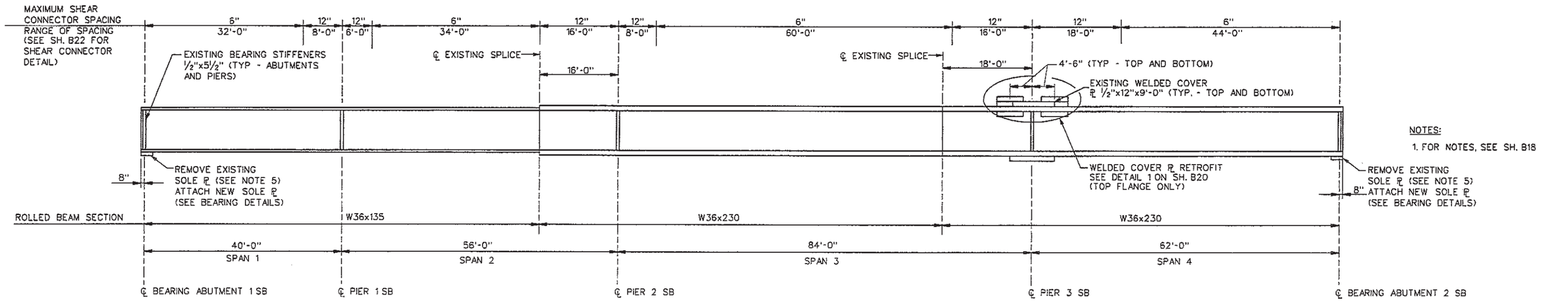
F8

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
W.V.	10	S328-77-6.94	IM-0771 (043)	2002	MERCER	38	58



FRAMING PLAN

10' 0 10'



GIRDER ELEVATION

10' 0 10'

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

I-77 OVER I-77 RAMP H
ROCKY HOLLOW BRIDGES
SOUTHBOUND FRAMING PLAN AND GIRDER ELEVATION

HDR ENGINEERING, INC.
CONSULTING ENGINEERS
WERTON, WV (304) 723-1010

DESIGNED JWB DATE 7-99	CHECKED MAB DATE 7-99	BRIDGE NO. 2432	
DRAWN TMD DATE 7-99	CHECKED MAB DATE 7-99	SHEET NO. B19 OF	

F9

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
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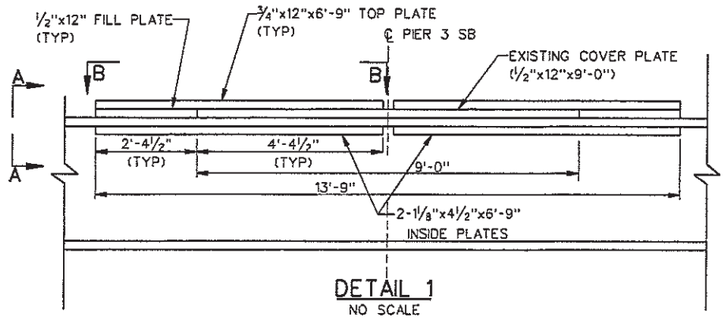

DETAIL 1
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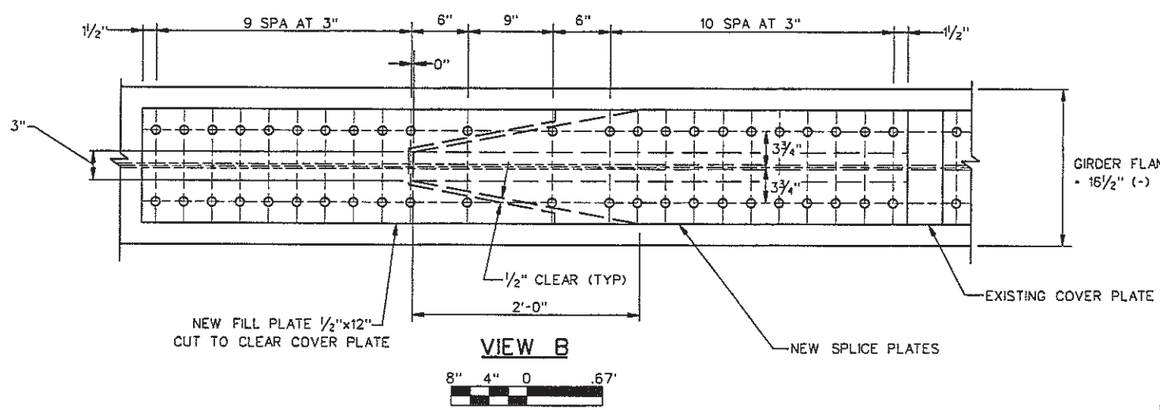
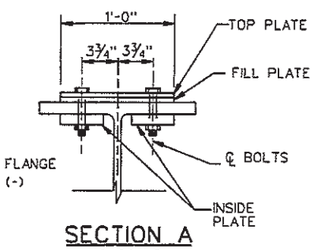


VIEW B

8" 4" 0 .67'



SECTION A
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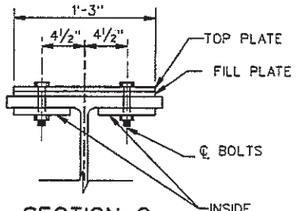

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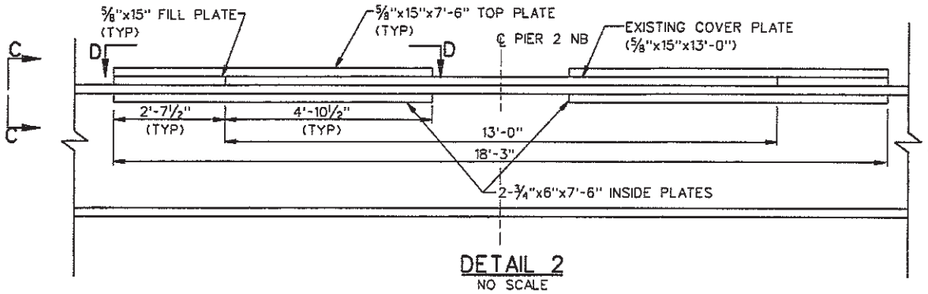

DETAIL 2
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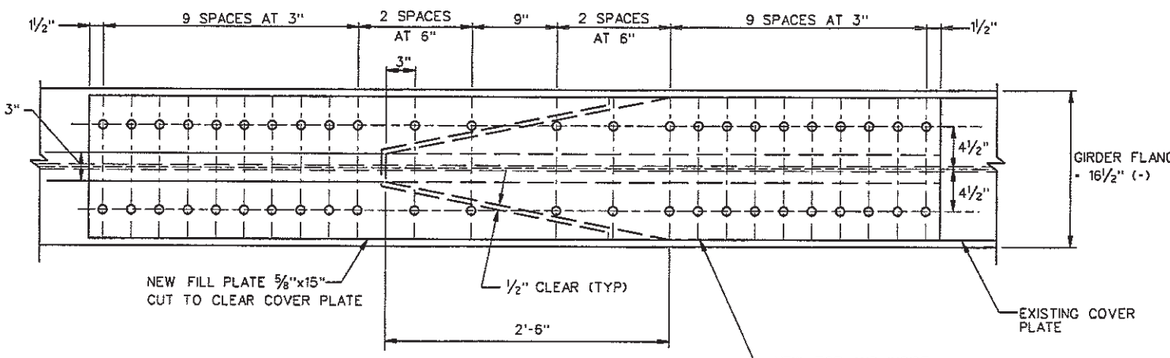
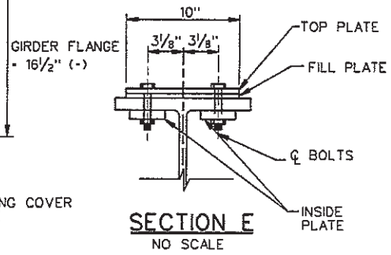


VIEW D

8" 4" 0 .67'



SECTION E
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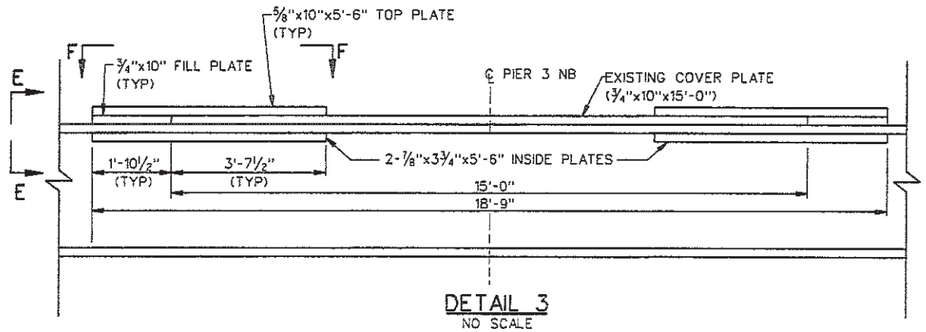

DETAIL 3
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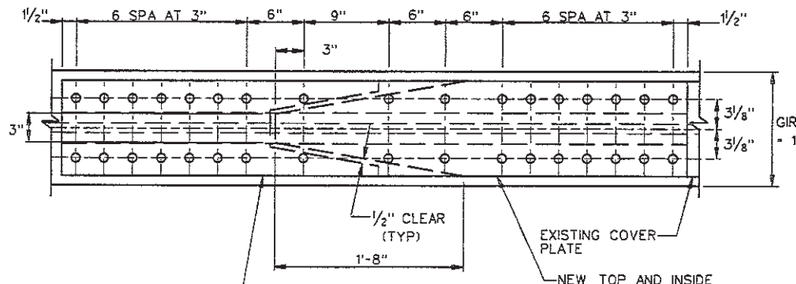

VIEW F

8" 4" 0 .67'

NOTES:

1. FOR GENERAL NOTES, SEE SH. B3 AND B4.
2. ALL COVER PLATE RETROFIT MATERIAL SHALL BE AASHTO M270, GRADE 50, AND SHALL BE CVN TESTED.
3. ALL BOLTS SHALL BE ⅞" DIAMETER HS BOLTS. ALL BOLT HOLES SHALL BE ⅝" DIAMETER. FIELD DRILL HOLES IN GIRDER FLANGE AND COVER PLATE AS REQUIRED.
4. PAINT NEW STEEL IN ACCORDANCE WITH THE GENERAL NOTES AND SECTION 688.

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

I-77 OVER I-77 RAMP H
ROCKY HOLLOW BRIDGES
STEEL DETAILS
COVER PLATE RETROFIT

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

HDR ENGINEERING, INC.
CONSULTING ENGINEERS
WERTON, WV (304) 723-1010

DESIGNED	JWB	DATE	7-99	CHECKED	MAB	DATE	7-99
DRAWN	JWB	DATE	7-99	CHECKED	MAB	DATE	7-99

BRIDGE NO. 2432
SHEET NO. 820 OF

Appendix G

Cost Estimates

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

SUMMARY OF COSTS FOR REPORT (2018 COST)

IN MILLIONS OF DOLLARS

REHABILITATION OPTION	SCHEME 1 (BASE COST)	TRAFFIC CONTROL SCHEME 2	TRAFFIC CONTROL SCHEME 3	TRAFFIC CONTROL SCHEME 4	TRAFFIC CONTROL SCHEME 5
T1	$22.4	$31.1	$36.6	$45.4	$37.9
T2	$19.0	$25.9	$30.1	$37.5	$31.7
T3	$27.7	$38.6	$45.7	$56.6	$47.1
T4	$26.3	$36.5	$42.9	$53.2	$44.5
A1	$8.1	$10.7	$12.2	$15.2	$13.2
A2	$11.7	$15.5	$17.5	$21.9	$19.0
A3	$5.8	$7.6	$8.6	$10.8	$9.3

REHABILITATION OPTION	SCHEME 1 (BASE COST)	TRAFFIC CONTROL SCHEME 2	TRAFFIC CONTROL SCHEME 3	TRAFFIC CONTROL SCHEME 4	TRAFFIC CONTROL SCHEME 5
T1+A1	$30.5	$41.8	$48.8	$60.6	$51.1
T2+A1	$27.1	$36.6	$42.3	$52.7	$44.9
T3+A2	$39.4	$54.1	$63.2	$78.5	$66.1
T4+A2	$38.0	$52.0	$60.4	$75.1	$63.5
T1+A3	$28.2	$38.7	$45.2	$56.2	$47.2
T2+A3	$24.8	$33.5	$38.7	$48.3	$41.0

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**A1 - Approach Unit - Replace deck with conventional deck; Perform required retrofits - No new walkway on existing bridge**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$127,638
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$145,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$1,272,500
SUPERSTRUCTURE - STEEL REPAIRS / MODIFICATIONS			$396,000
SUPERSTRUCTURE - PAINTING			$3,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$116,000
A	Total of Estimated Items		$5,557,138
B	Miscellaneous Items Not Estimated (% of A)	10%	$555,714
A + B	Base Estimate in 2012 dollars		$6,112,852
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$8,130,093**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$8,130,093
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Contingency (% of C+D)	0%	$0
Total Cost Estimate			**$8,130,093**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$8,130,093
D	Adjustment for Construction Staging Considerations (% of C)	20%	$1,626,019
E	Contingency (% of C+D)	10%	$975,611
Total Cost Estimate			**$10,731,723**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$8,130,093
D	Adjustment for Construction Staging Considerations (% of C)	30%	$2,439,028
E	Contingency (% of C+D)	15%	$1,585,368
Total Cost Estimate			**$12,154,489**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$8,130,093
D	Adjustment for Construction Staging Considerations (% of C)	50%	$4,065,047
E	Contingency (% of C+D)	25%	$3,048,785
Total Cost Estimate			**$15,243,925**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$8,130,093
D	Adjustment for Construction Staging Considerations (% of C)	35%	$2,845,533
E	Contingency (% of C+D)	20%	$2,195,125
Total Cost Estimate			**$13,170,751**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **A1 - Approach Unit - Replace deck with conventional deck; Perform required retrofits - No new walkway on existing bridge**

SUMMARY OF ESTIMATED QUANTITIES

Item No.	Description	Unit	Approach Superstr.	Pier No. 4	Pier No. 5	Pier No. 6	Pier No. 7	Pier No. 8	Abut. No. 2	Option Total	Unit Price	Basis for Unit Price	Total Price	Quantity Groups for Summary
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	28,364							28,364	$4.50		$127,638.00	$127,638
TBD	ABUTMENT 2 AND PIER 8 RETROFIT	EA						1	1	2	$20,000.00		$40,000.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - NEW COLUMNS FOR SW GIRDERS	CY								0	$500.00		$0.00	
2453.603	DRILLED SHAFTS - (SIZE TBD) FOR SW GIRDER COLUMNS	LF								0	$750.00		$0.00	$145,000
2401.541	REINFORCEMENT BARS - (EPOXY)	LB								0	$1.50		$0.00	
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	50	50	50	50	50	300	$250.00		$75,000.00	
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	50	50	50	50	50	300	$100.00		$30,000.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - SLAB (8 1/2" THICK)	CY	770							770	$750.00		$577,500.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - BARRIERS	CY	95							95	$1,000.00		$95,000.00	$1,272,500
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - SLAB AND BARRIERS	LB	200,000							200,000	$3.00		$600,000.00	
2433.608	STRUCTURAL STEEL - APPROACH GIRDER SPLICES	LB	30,000							30,000	$5.00		$150,000.00	
2433.608	STRUCTURAL STEEL - APPROACH GIRDER FLEXURE STRENGTHENING	LB	40,000							40,000	$5.00		$200,000.00	
2433.608	STRUCTURAL STEEL - APPROACH GIRDER SHEAR STRENGHTENING	LB	2,000							2,000	$5.00		$10,000.00	$396,000
2433.608	STRUCTURAL STEEL - APPROACHES - NEW SIDEWALK STRINGERS	LB								0	$2.50		$0.00	
2433.608	STRUCTURAL STEEL - ADD STUDS FOR GIRDERS	EA	12,000							12,000	$3.00		$36,000.00	
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - APPROACH	LS	1							1	$1,750,000.00		$1,750,000.00	$3,500,000
2476.601	WASTE COLLECTION AND DISPOSAL - APPROACH	LS	1							1	$1,750,000.00		$1,750,000.00	
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF								0	$250.00		$0.00	
2402.591	EXPANSION JOINT DEVICES TYPE TBD (2 LOCATIONS)	LF	70							70	$300.00		$21,000.00	
2402.595	APPROACH BEARING MODIFICATION / REPLACEMENT	EA	35							35	$1,000.00		$35,000.00	$116,000
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1							1	$10,000.00		$10,000.00	
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1							1	$50,000.00		$50,000.00	
Subtotal													$5,557,138.00	$5,557,138

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**A2 - Approach Unit - Add sidewalks; Replace deck with conventional deck; Perform required retrofits**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$127,638
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$811,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$1,692,500
SUPERSTRUCTURE - STEEL REPAIRS / MODIFICATIONS			$1,371,000
SUPERSTRUCTURE - PAINTING			$3,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$499,500
A	Total of Estimated Items		$8,001,638
B	Miscellaneous Items Not Estimated (% of A)	10%	$800,164
A + B	Base Estimate in 2012 dollars		$8,801,802
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$11,706,397**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$11,706,397
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Contingency (% of C+D)	0%	$0
Total Cost Estimate			**$11,706,397**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$11,706,397
D	Adjustment for Construction Staging Considerations (% of C)	20%	$2,341,279
E	Contingency (% of C+D)	10%	$1,404,768
Total Cost Estimate			**$15,452,444**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$11,706,397
D	Adjustment for Construction Staging Considerations (% of C)	30%	$3,511,919
E	Contingency (% of C+D)	15%	$2,282,747
Total Cost Estimate			**$17,501,063**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$11,706,397
D	Adjustment for Construction Staging Considerations (% of C)	50%	$5,853,198
E	Contingency (% of C+D)	25%	$4,389,899
Total Cost Estimate			**$21,949,494**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$11,706,397
D	Adjustment for Construction Staging Considerations (% of C)	35%	$4,097,239
E	Contingency (% of C+D)	20%	$3,160,727
Total Cost Estimate			**$18,964,363**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **A2 - Approach Unit - Add sidewalks; Replace deck with conventional deck; Perform required retrofits**

SUMMARY OF ESTIMATED QUANTITIES													
Item No.	Description	Unit	Approach Superstr.	Pier No. 4	Pier No. 5	Pier No. 6	Pier No. 7	Pier No. 8	Abut. No. 2	Option Total	Unit Price	Basis for Unit Price	Total Price
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	28,364							28,364	$4.50		$127,638.00
TBD	ABUTMENT 2 AND PIER 8 RETROFIT	EA						1	1	2	$20,000.00		$40,000.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - NEW COLUMNS FOR SW GIRDERS	CY		64	62	54	46	24	20	270	$500.00		$135,000.00
2453.603	DRILLED SHAFTS - (SIZE TBD) FOR SW GIRDER COLUMNS	LF		100	100	100	100	100	100	600	$750.00		$450,000.00
2401.541	REINFORCEMENT BARS - (EPOXY)	LB		12,800	12,400	10,800	9,200	4,800	4,000	54,000	$1.50		$81,000.00
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	50	50	50	50	50	300	$250.00		$75,000.00
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	50	50	50	50	50	300	$100.00		$30,000.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - SLAB (8 1/2" THICK)	CY	1,090							1,090	$750.00		$817,500.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - BARRIERS	CY	95							95	$1,000.00		$95,000.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - SLAB AND BARRIERS	LB	260,000							260,000	$3.00		$780,000.00
2433.608	STRUCTURAL STEEL - APPROACH GIRDER SPLICES	LB	30,000							30,000	$5.00		$150,000.00
2433.608	STRUCTURAL STEEL - APPROACH GIRDER FLEXURE STRENGTHENING	LB	40,000							40,000	$5.00		$200,000.00
2433.608	STRUCTURAL STEEL - APPROACH GIRDER SHEAR STRENGHTENING	LB	2,000							2,000	$5.00		$10,000.00
2433.608	STRUCTURAL STEEL - APPROACHES - NEW SIDEWALK STRINGERS	LB	390,000							390,000	$2.50		$975,000.00
2433.608	STRUCTURAL STEEL - ADD STUDS FOR GIRDERS	EA	12,000							12,000	$3.00		$36,000.00
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - APPROACH	LS	1							1	$1,750,000.00		$1,750,000.00
2476.601	WASTE COLLECTION AND DISPOSAL - APPROACH	LS	1							1	$1,750,000.00		$1,750,000.00
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF	1,534							1,534	$250.00		$383,500.00
2402.591	EXPANSION JOINT DEVICES TYPE TBD (2 LOCATIONS)	LF	70							70	$300.00		$21,000.00
2402.595	APPROACH BEARING MODIFICATION / REPLACEMENT	EA	35							35	$1,000.00		$35,000.00
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1							1	$10,000.00		$10,000.00
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1							1	$50,000.00		$50,000.00
Subtotal													$8,001,638.00

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**A3 - Approach Unit - Superstructure replacement; Perform required retrofits on substructure; no new walkway**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$212,730
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$145,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$1,272,500
SUPERSTRUCTURE - NEW STEEL			$2,200,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$106,400
A	Total of Estimated Items		$3,936,630
B	Miscellaneous Items Not Estimated (% of A)	10%	$393,663
A + B	Base Estimate in 2012 dollars		$4,330,293
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$5,759,290**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$5,759,290
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Contingency (% of C+D)	0%	$0
Total Cost Estimate			**$5,759,290**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$5,759,290
D	Adjustment for Construction Staging Considerations (% of C)	20%	$1,151,858
E	Contingency (% of C+D)	10%	$691,115
Total Cost Estimate			**$7,602,263**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$5,759,290
D	Adjustment for Construction Staging Considerations (% of C)	30%	$1,727,787
E	Contingency (% of C+D)	15%	$1,123,062
Total Cost Estimate			**$8,610,139**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$5,759,290
D	Adjustment for Construction Staging Considerations (% of C)	50%	$2,879,645
E	Contingency (% of C+D)	25%	$2,159,734
Total Cost Estimate			**$10,798,669**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$5,759,290
D	Adjustment for Construction Staging Considerations (% of C)	35%	$2,015,751
E	Contingency (% of C+D)	20%	$1,555,008
Total Cost Estimate			**$9,330,049**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **A3 - Approach Unit - Superstructure replacement; Perform required retrofits on substructure; no new walkway**

SUMMARY OF ESTIMATED QUANTITIES														Quantity Groups for Summary
Item No.	Description	Unit	Approach Superstr.	Pier No. 4	Pier No. 5	Pier No. 6	Pier No. 7	Pier No. 8	Abut. No. 2	Option Total	Unit Price	Basis for Unit Price	Total Price	
2433.505	REMOVE SUPERSTRUCTURE	SF	28,364							28,364	$7.50		$212,730.00	$212,730
TBD	ABUTMENT 2 AND PIER 8 RETROFIT	EA						1	1	2	$20,000.00		$40,000.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - NEW COLUMNS FOR SW GIRDERS	CY								0	$500.00		$0.00	
2453.603	DRILLED SHAFTS - (SIZE TBD) FOR SW GIRDER COLUMNS	LF								0	$750.00		$0.00	$145,000
2401.541	REINFORCEMENT BARS - (EPOXY)	LB								0	$1.50		$0.00	
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	50	50	50	50	50	300	$250.00		$75,000.00	
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	50	50	50	50	50	300	$100.00		$30,000.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - SLAB (8 1/2" THICK)	CY	770							770	$750.00		$577,500.00	
2401.501	STRUCTURAL CONCRETE (3Y33A) - BARRIERS	CY	95							95	$1,000.00		$95,000.00	$1,272,500
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - SLAB AND BARRIERS	LB	200,000							200,000	$3.00		$600,000.00	
2402.521	STRUCTURAL STEEL 50W (3309)	LB	1,100,000							1,100,000	$2.00		$2,200,000.00	$2,200,000
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF								0	$250.00		$0.00	
2402.591	EXPANSION JOINT DEVICES TYPE 4 (1 LOCATION)	LF	38							38	$300.00		$11,400.00	
2402.595	APPROACH BEARING REPLACEMENT	EA	35							35	$1,000.00		$35,000.00	$106,400
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1							1	$10,000.00		$10,000.00	
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1							1	$50,000.00		$50,000.00	
Subtotal													$3,936,630.00	$3,936,630

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**T1 - Truss Unit - Replace deck with conventional deck; Perform required retrofits - No new walkway on existing bridge**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$148,500
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$2,105,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$1,662,500
SUPERSTRUCTURE - TRUSS MEMBER/GUSSET REPAIRS			$5,520,000
SUPERSTRUCTURE - OTHER STEEL REPAIRS / MODIFICATIONS			$1,088,000
SUPERSTRUCTURE - PAINTING			$4,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$278,000
A	Total of Estimated Items		$15,302,000
B	Miscellaneous Items Not Estimated (% of A)	10%	$1,530,200
A + B	Base Estimate in 2012 dollars		$16,832,200
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$22,386,826**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$22,386,826
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	0%	$0
F	Contingency (% of C+D+E)	0%	$0
Total Cost Estimate			**$22,386,826**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$22,386,826
D	Adjustment for Construction Staging Considerations (% of C)	20%	$4,477,365
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,380,000
F	Contingency (% of C+D+E)	10%	$2,824,419
Total Cost Estimate			**$31,068,610**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$22,386,826
D	Adjustment for Construction Staging Considerations (% of C)	30%	$6,716,048
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$2,760,000
F	Contingency (% of C+D+E)	15%	$4,779,431
Total Cost Estimate			**$36,642,305**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$22,386,826
D	Adjustment for Construction Staging Considerations (% of C)	50%	$11,193,413
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$2,760,000
F	Contingency (% of C+D+E)	25%	$9,085,060
Total Cost Estimate			**$45,425,299**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$22,386,826
D	Adjustment for Construction Staging Considerations (% of C)	35%	$7,835,389
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,380,000
F	Contingency (% of C+D+E)	20%	$6,320,443
Total Cost Estimate			**$37,922,658**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T1 - Truss Unit - Replace deck with conventional deck; Perform required retrofits - No new walkway on existing bridge**

SUMMARY OF ESTIMATED QUANTITIES

Item No.	Description	Unit	Truss Superstr.	Abut. No. 1	Pier No. 1	Pier No. 2	Pier No. 3	Option Total	Unit Price	Basis for Unit Price	Total Price
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	33,000					33,000	$4.50		$148,500.00
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	100	100	50	300	$250.00		$75,000.00
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	100	100	50	300	$100.00		$30,000.00
TBD	MODIFICATIONS TO RIVER PIER 1 - SUBSTRUCTURE	LS			1			1	$500,000.00		$500,000.00
TBD	MODIFICATIONS TO RIVER PIER 2 - SUBSTRUCTURE	LS			1			1	$1,500,000.00		$1,500,000.00
TBD	EXODERMIC DECK - TRUSS SPANS SLAB	SF						0	$35.00		$0.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SLAB (8 1/2" THICK)	CY	870					870	$750.00		$652,500.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS BARRIERS	CY	110					110	$1,000.00		$110,000.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS	LB	300,000					300,000	$3.00		$900,000.00
TBD	GRID DECK - TRUSS SIDEWALK	SF						0	$20.00		$0.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SIDEWALK (4" THICK)	CY						0	$750.00		$0.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS WALK	LB						0	$3.00		$0.00
2433.608	STRUCTURAL STEEL - TRUSS MEMBER MODIFICATIONS	EA	92					92	$60,000.00		$5,520,000.00
2433.608	STRUCTURAL STEEL - TRUSS GUSSET PLATE MODIFICATIONS	EA						0	$25,000.00		$0.00
2433.608	STRUCTURAL STEEL - FLOOR BEAM COVER PLATE RETROFITS	EA	54					54	$10,000.00		$540,000.00
2433.608	STRUCTURAL STEEL - SIDEWALK BRACKETS AND STRINGERS	LB						0	$2.00		$0.00
2433.608	STRUCTURAL STEEL - ADD STUDS FOR FLOORSYSTEM	EA	16,000					16,000	$3.00		$48,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 1 (SECONDARY MEMBERS)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 2 (PACK RUST)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 3 (TBD)	LS	0					0	$0.00		$0.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 4 (TBD)	LS	0					0	$0.00		$0.00
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - TRUSS	LS	1					1	$1,800,000.00		$1,800,000.00
2476.601	WASTE COLLECTION AND DISPOSAL - TRUSS	LS	1					1	$2,700,000.00		$2,700,000.00
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF						0	$250.00		$0.00
2402.585	PIPE RAILING - SIDEWALK INSIDE EDGE	LF						0	$50.00		$0.00
2402.603	MODULAR BRIDGE JOINT SYSTEM (3 LOCATIONS)	LF	105					105	$1,500.00		$157,500.00
2402.591	EXPANSION JOINT DEVICES TYPE TBD (1 LOCATION)	LF	35					35	$300.00		$10,500.00
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1					1	$10,000.00		$10,000.00
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1					1	$50,000.00		$50,000.00
TBD	NAVIGATION LIGHTING SYSTEM REPAIR/REPLACEMENT	LS	1					1	$50,000.00		$50,000.00
Subtotal											$15,302,000.00

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**T2 - Truss Unit - Replace deck with lightweight deck; Perform required retrofits - No new walkway on existing bridge**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$148,500
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$2,105,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$2,016,900
SUPERSTRUCTURE - TRUSS MEMBER/GUSSET REPAIRS			$2,880,000
SUPERSTRUCTURE - OTHER STEEL REPAIRS / MODIFICATIONS			$1,088,000
SUPERSTRUCTURE - PAINTING			$4,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$278,000
A	Total of Estimated Items		$13,016,400
B	Miscellaneous Items Not Estimated (% of A)	10%	$1,301,640
A + B	Base Estimate in 2012 dollars		$14,318,040
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$19,042,993**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$19,042,993
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	0%	$0
F	Contingency (% of C+D+E)	0%	$0
Total Cost Estimate			**$19,042,993**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$19,042,993
D	Adjustment for Construction Staging Considerations (% of C)	20%	$3,808,599
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$720,000
F	Contingency (% of C+D+E)	10%	$2,357,159
Total Cost Estimate			**$25,928,751**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$19,042,993
D	Adjustment for Construction Staging Considerations (% of C)	30%	$5,712,898
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$1,440,000
F	Contingency (% of C+D+E)	15%	$3,929,384
Total Cost Estimate			**$30,125,275**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$19,042,993
D	Adjustment for Construction Staging Considerations (% of C)	50%	$9,521,497
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$1,440,000
F	Contingency (% of C+D+E)	25%	$7,501,123
Total Cost Estimate			**$37,505,613**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$19,042,993
D	Adjustment for Construction Staging Considerations (% of C)	35%	$6,665,048
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$720,000
F	Contingency (% of C+D+E)	20%	$5,285,608
Total Cost Estimate			**$31,713,649**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T2 - Truss Unit - Replace deck with lightweight deck; Perform required retrofits - No new walkway on existing bridge**

SUMMARY OF ESTIMATED QUANTITIES

Item No.	Description	Unit	Truss Superstr.	Abut. No. 1	Pier No. 1	Pier No. 2	Pier No. 3	Option Total	Unit Price	Basis for Unit Price	Total Price
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	33,000					33,000	$4.50		$148,500.00
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	100	100	50	300	$250.00		$75,000.00
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	100	100	50	300	$100.00		$30,000.00
TBD	MODIFICATIONS TO RIVER PIER 1 - SUBSTRUCTURE	LS			1			1	$500,000.00		$500,000.00
TBD	MODIFICATIONS TO RIVER PIER 2 - SUBSTRUCTURE	LS			1			1	$1,500,000.00		$1,500,000.00
TBD	EXODERMIC DECK - TRUSS SPANS SLAB	SF	32,840					32,840	$35.00		$1,149,400.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SLAB (8 1/2" THICK)	CY	410					410	$750.00		$307,500.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS BARRIERS	CY	110					110	$1,000.00		$110,000.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS	LB	150,000					150,000	$3.00		$450,000.00
TBD	GRID DECK - TRUSS SIDEWALK	SF						0	$20.00		$0.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SIDEWALK (4" THICK)	CY						0	$750.00		$0.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS WALK	LB						0	$3.00		$0.00
2433.608	STRUCTURAL STEEL - TRUSS MEMBER MODIFICATIONS	EA	48					48	$60,000.00		$2,880,000.00
2433.608	STRUCTURAL STEEL - TRUSS GUSSET PLATE MODIFICATIONS	EA						0	$25,000.00		$0.00
2433.608	STRUCTURAL STEEL - FLOOR BEAM COVER PLATE RETROFITS	EA	54					54	$10,000.00		$540,000.00
2433.608	STRUCTURAL STEEL - SIDEWALK BRACKETS AND STRINGERS	LB						0	$2.00		$0.00
2433.608	STRUCTURAL STEEL - ADD STUDS FOR FLOORSYSTEM	EA	16,000					16,000	$3.00		$48,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 1 (SECONDARY MEMBERS)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 2 (PACK RUST)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 3 (TBD)	LS	0					0	$0.00		$0.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 4 (TBD)	LS	0					0	$0.00		$0.00
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - TRUSS	LS	1					1	$1,800,000.00		$1,800,000.00
2476.601	WASTE COLLECTION AND DISPOSAL - TRUSS	LS	1					1	$2,700,000.00		$2,700,000.00
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF						0	$250.00		$0.00
2402.585	PIPE RAILING - SIDEWALK INSIDE EDGE	LF						0	$50.00		$0.00
2402.603	MODULAR BRIDGE JOINT SYSTEM (3 LOCATIONS)	LF	105					105	$1,500.00		$157,500.00
2402.591	EXPANSION JOINT DEVICES TYPE TBD (1 LOCATION)	LF	35					35	$300.00		$10,500.00
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1					1	$10,000.00		$10,000.00
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1					1	$50,000.00		$50,000.00
TBD	NAVIGATION LIGHTING SYSTEM REPAIR/REPLACEMENT	LS	1					1	$50,000.00		$50,000.00
Subtotal											$13,016,400.00

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**T3 - Truss Unit - Add sidewalks; Replace deck with conventional deck; Perform required retrofits**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$148,500
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$2,105,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$2,221,750
SUPERSTRUCTURE - TRUSS MEMBER/GUSSET REPAIRS			$7,510,000
SUPERSTRUCTURE - OTHER STEEL REPAIRS / MODIFICATIONS			$1,608,000
SUPERSTRUCTURE - PAINTING			$4,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$812,600
A	Total of Estimated Items		$18,905,850
B	Miscellaneous Items Not Estimated (% of A)	10%	$1,890,585
A + B	Base Estimate in 2012 dollars		$20,796,435
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$27,659,259**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$27,659,259
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	0%	$0
F	Contingency (% of C+D+E)	0%	$0
Total Cost Estimate			**$27,659,259**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$27,659,259
D	Adjustment for Construction Staging Considerations (% of C)	20%	$5,531,852
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,877,500
F	Contingency (% of C+D+E)	10%	$3,506,861
Total Cost Estimate			**$38,575,472**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$27,659,259
D	Adjustment for Construction Staging Considerations (% of C)	30%	$8,297,778
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$3,755,000
F	Contingency (% of C+D+E)	15%	$5,956,805
Total Cost Estimate			**$45,668,842**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$27,659,259
D	Adjustment for Construction Staging Considerations (% of C)	50%	$13,829,629
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$3,755,000
F	Contingency (% of C+D+E)	25%	$11,310,972
Total Cost Estimate			**$56,554,860**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$27,659,259
D	Adjustment for Construction Staging Considerations (% of C)	35%	$9,680,740
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,877,500
F	Contingency (% of C+D+E)	20%	$7,843,500
Total Cost Estimate			**$47,060,999**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T3 - Truss Unit - Add sidewalks; Replace deck with conventional deck; Perform required retrofits**

SUMMARY OF ESTIMATED QUANTITIES											
Item No.	Description	Unit	Truss Superstr.	Abut. No. 1	Pier No. 1	Pier No. 2	Pier No. 3	Option Total	Unit Price	Basis for Unit Price	Total Price
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	33,000					33,000	$4.50		$148,500.00
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	100	100	50	300	$250.00		$75,000.00
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	100	100	50	300	$100.00		$30,000.00
TBD	MODIFICATIONS TO RIVER PIER 1 - SUBSTRUCTURE	LS			1			1	$500,000.00		$500,000.00
TBD	MODIFICATIONS TO RIVER PIER 2 - SUBSTRUCTURE	LS			1			1	$1,500,000.00		$1,500,000.00
TBD	EXODERMIC DECK - TRUSS SPANS SLAB	SF						0	$35.00		$0.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SLAB (8 1/2" THICK)	CY	870					870	$750.00		$652,500.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS BARRIERS	CY	110					110	$1,000.00		$110,000.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS	LB	300,000					300,000	$3.00		$900,000.00
TBD	GRID DECK - TRUSS SIDEWALK	SF	13,900					13,900	$20.00		$278,000.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SIDEWALK (4" THICK)	CY	175					175	$750.00		$131,250.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS WALK	LB	50,000					50,000	$3.00		$150,000.00
2433.608	STRUCTURAL STEEL - TRUSS MEMBER MODIFICATIONS	EA	116					116	$60,000.00		$6,960,000.00
2433.608	STRUCTURAL STEEL - TRUSS GUSSET PLATE MODIFICATIONS	EA	22					22	$25,000.00		$550,000.00
2433.608	STRUCTURAL STEEL - FLOOR BEAM COVER PLATE RETROFITS	EA	54					54	$10,000.00		$540,000.00
2433.608	STRUCTURAL STEEL - SIDEWALK BRACKETS AND STRINGERS	LB	260,000					260,000	$2.00		$520,000.00
2433.608	STRUCTURAL STEEL - ADD STUDS FOR FLOORSYSTEM	EA	16,000					16,000	$3.00		$48,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 1 (SECONDARY MEMBERS)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 2 (PACK RUST)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 3 (TBD)	LS	0					0	$0.00		$0.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 4 (TBD)	LS	0					0	$0.00		$0.00
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - TRUSS	LS	1					1	$1,800,000.00		$1,800,000.00
2476.601	WASTE COLLECTION AND DISPOSAL - TRUSS	LS	1					1	$2,700,000.00		$2,700,000.00
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF	1,782					1,782	$250.00		$445,500.00
2402.585	PIPE RAILING - SIDEWALK INSIDE EDGE	LF	1,782					1,782	$50.00		$89,100.00
2402.603	MODULAR BRIDGE JOINT SYSTEM (3 LOCATIONS)	LF	105					105	$1,500.00		$157,500.00
2402.591	EXPANSION JOINT DEVICES TYPE TBD (1 LOCATION)	LF	35					35	$300.00		$10,500.00
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1					1	$10,000.00		$10,000.00
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1					1	$50,000.00		$50,000.00
TBD	NAVIGATION LIGHTING SYSTEM REPAIR/REPLACEMENT	LS	1					1	$50,000.00		$50,000.00
Subtotal											$18,905,850.00

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option:	**T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**		
Description		Estimated Cost	
PARTIAL DEMOLITION OF EXISTING STRUCTURE			$148,500
SUBSTRUCTURE - REPAIRS / MODIFICATIONS			$2,105,000
SUPERSTRUCTURE - NEW DECK AND BARRIERS			$2,576,150
SUPERSTRUCTURE - TRUSS MEMBER/GUSSET REPAIRS			$6,240,000
SUPERSTRUCTURE - OTHER STEEL REPAIRS / MODIFICATIONS			$1,608,000
SUPERSTRUCTURE - PAINTING			$4,500,000
BRIDGE APPURTENANCES (RAILINGS, JOINTS, BEARINGS, ETC.)			$812,600
A	Total of Estimated Items		$17,990,250
B	Miscellaneous Items Not Estimated (% of A)	10%	$1,799,025
A + B	Base Estimate in 2012 dollars		$19,789,275
Subtotal for 2018	Base Estimate in 2012 dollars x Escalation Factor (Per MnDOT)	133%	**$26,319,736**

Construction Scenario:	**1 - Work performed following construction of a new 2-lane bridge, therefore no staging considerations**		
C	Subtotal from Above		$26,319,736
D	Adjustment for Construction Staging Considerations (% of C)	0%	$0
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	0%	$0
F	Contingency (% of C+D+E)	0%	$0
Total Cost Estimate			**$26,319,736**

Construction Scenario:	**2 - Work performed half-width ; one lane closed full time during entire duration of rehabilitation**		
C	Subtotal from Above		$26,319,736
D	Adjustment for Construction Staging Considerations (% of C)	20%	$5,263,947
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,560,000
F	Contingency (% of C+D+E)	10%	$3,314,368
Total Cost Estimate			**$36,458,051**

Construction Scenario:	**3 - Work performed during 8-hour night closures ; entire bridge closed at night, fully open during day**		
C	Subtotal from Above		$26,319,736
D	Adjustment for Construction Staging Considerations (% of C)	30%	$7,895,921
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$3,120,000
F	Contingency (% of C+D+E)	15%	$5,600,349
Total Cost Estimate			**$42,936,006**

Construction Scenario:	**4 - Work performed during 8-hour night closures ; one lane open at night, fully open during day**		
C	Subtotal from Above		$26,319,736
D	Adjustment for Construction Staging Considerations (% of C)	50%	$13,159,868
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	50%	$3,120,000
F	Contingency (% of C+D+E)	25%	$10,649,901
Total Cost Estimate			**$53,249,505**

Construction Scenario:	**5 - One lane closed during day, complete closure at night**		
C	Subtotal from Above		$26,319,736
D	Adjustment for Construction Staging Considerations (% of C)	35%	$9,211,908
E	Adjustment for Increased Truss Repairs (% of Truss Member/Gusset Repairs)	25%	$1,560,000
F	Contingency (% of C+D+E)	20%	$7,418,329
Total Cost Estimate			**$44,509,973**

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

SUMMARY OF ESTIMATED QUANTITIES

Item No.	Description	Unit	Truss Superstr.	Abut. No. 1	Pier No. 1	Pier No. 2	Pier No. 3	Option Total	Unit Price	Basis for Unit Price	Total Price
2433.505	REMOVE CONCRETE SLAB, OVERLAY AND RAIL	SF	33,000					33,000	$4.50		$148,500.00
2433.618	CONCRETE SURFACE REPAIR - SUBSTRUCTURE	SF		50	100	100	50	300	$250.00		$75,000.00
2433.603	REPAIR STRUCTURAL CRACKS - SUBSTRUCTURE	LF		50	100	100	50	300	$100.00		$30,000.00
TBD	MODIFICATIONS TO RIVER PIER 1 - SUBSTRUCTURE	LS			1			1	$500,000.00		$500,000.00
TBD	MODIFICATIONS TO RIVER PIER 2 - SUBSTRUCTURE	LS			1			1	$1,500,000.00		$1,500,000.00
TBD	EXODERMIC DECK - TRUSS SPANS SLAB	SF	32,840					32,840	$35.00		$1,149,400.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SLAB (8 1/2" THICK)	CY	410					410	$750.00		$307,500.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS BARRIERS	CY	110					110	$1,000.00		$110,000.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS	LB	150,000					150,000	$3.00		$450,000.00
TBD	GRID DECK - TRUSS SIDEWALK	SF	13,900					13,900	$20.00		$278,000.00
2401.501	STRUCTURAL CONCRETE (3Y33A) - TRUSS SIDEWALK (4" THICK)	CY	175					175	$750.00		$131,250.00
2401.541	REINFORCEMENT BARS (STAINLESS STEEL) - TRUSS SPANS WALK	LB	50,000					50,000	$3.00		$150,000.00
2433.608	STRUCTURAL STEEL - TRUSS MEMBER MODIFICATIONS	EA	104					104	$60,000.00		$6,240,000.00
2433.608	STRUCTURAL STEEL - TRUSS GUSSET PLATE MODIFICATIONS	EA						0	$25,000.00		$0.00
2433.608	STRUCTURAL STEEL - FLOOR BEAM COVER PLATE RETROFITS	EA	54					54	$10,000.00		$540,000.00
2433.608	STRUCTURAL STEEL - SIDEWALK BRACKETS AND STRINGERS	LB	260,000					260,000	$2.00		$520,000.00
2433.608	STRUCTURAL STEEL - ADD STUDS FOR FLOORSYSTEM	EA	16,000					16,000	$3.00		$48,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 1 (SECONDARY MEMBERS)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 2 (PACK RUST)	LS	1					1	$250,000.00		$250,000.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 3 (TBD)	LS	0					0	$0.00		$0.00
2433.608	TRUSS - MISCELLANEOUS STEEL REPAIR 4 (TBD)	LS	0					0	$0.00		$0.00
2478.503	ORGANIC ZINC-RICH PAINT SYSTEM (FIELD) - TRUSS	LS	1					1	$1,800,000.00		$1,800,000.00
2476.601	WASTE COLLECTION AND DISPOSAL - TRUSS	LS	1					1	$2,700,000.00		$2,700,000.00
2402.583	ORNAMENTAL METAL RAILING - SIDEWALK OUTSIDE EDGE	LF	1,782					1,782	$250.00		$445,500.00
2402.585	PIPE RAILING - SIDEWALK INSIDE EDGE	LF	1,782					1,782	$50.00		$89,100.00
2402.603	MODULAR BRIDGE JOINT SYSTEM (3 LOCATIONS)	LF	105					105	$1,500.00		$157,500.00
2402.591	EXPANSION JOINT DEVICES TYPE TBD (1 LOCATION)	LF	35					35	$300.00		$10,500.00
2545.509	CONDUIT SYSTEM (LIGHTING)	EA	1					1	$10,000.00		$10,000.00
2502.601	DRAINAGE SYSTEM (BRIDGE DECK)	EA	1					1	$50,000.00		$50,000.00
TBD	NAVIGATION LIGHTING SYSTEM REPAIR/REPLACEMENT	LS	1					1	$50,000.00		$50,000.00
Subtotal											$17,990,250.00

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

SUMMARY OF ESTIMATED QUANTITIES						LABOR @ $60.00/hr			EQUIPMENT		PERM MATLERIAL		EXP MATLERIAL	
Item No.	Description	Unit	Option Total	Unit Price	Total Price	%	$	MH	%	$	%	$	%	$
	MOBILIZATION	LS	1	$500,000.00	$500,000.00	14%	$ 70,000	1,166.67	10%	$ 50,000	0%		50%	$ 250,000
	REMOVE CONCRETE BRIDGE DECK AND BARRIERS	CY	950	$150.00	$142,500.00	35%	$ 49,875	831.25	35%	$ 49,875	0%		4%	$ 5,700
	SUBSTRUCTURE - CONCRETE SURFACE REPAIR	SF	300	$250.00	$75,000.00	45%	$ 33,750	562.50	18%	$ 13,500	5%	$3,750.00	6%	$ 4,500
	SUBSTRUCTURE - REPAIR STRUCTURAL CRACKS	LF	300	$100.00	$30,000.00	45%	$ 13,500	225.00	18%	$ 5,400	5%	$1,500.00	6%	$ 1,800
	BRIDGE SLAB - EXODERMIC DECK - TRUSS SPANS	SF	32,840	$35.00	$1,149,400.00	40%	$ 459,760	7,662.67	6%	$ 68,964	16%	$183,904.00	12%	$ 137,928
	BRIDGE SLAB - CONCRETE - TRUSS SPANS (4" THICKNESS)	CY	410	$750.00	$307,500.00	40%	$ 123,000	2,050.00	6%	$ 18,450	16%	$49,200.00	12%	$ 36,900
	BRIDGE BARRIERS - CONCRETE - TRUSS SPANS	CY	110	$1,000.00	$110,000.00	33%	$ 36,300	605.00	10%	$ 11,000	18%	$19,800.00	13%	$ 14,300
	REINFORCEMENT BAR (STAINLESS STEEL) - TRUSS SPANS	LB	150,000	$3.00	$450,000.00	12%	$ 54,000	900.00	7%	$ 31,500	50%	$225,000.00	5%	$ 22,500
	BRIDGE SIDEWALK SLAB - GRID DECK - TRUSS SPANS	SF	13,900	$20.00	$278,000.00	33%	$ 91,740	1,529.00	10%	$ 27,800	18%	$50,040.00	13%	$ 36,140
	BRIDGE SIDEWALK SLAB - CONCRETE - TRUSS SPANS (4" THICK)	CY	175	$750.00	$131,250.00	33%	$ 43,313	721.88	10%	$ 13,125	18%	$23,625.00	13%	$ 17,063
	REINFORCEMENT BAR (STAINLESS STEEL) - TRUSS SPANS	LB	50,000	$3.00	$150,000.00	12%	$ 18,000	300.00	7%	$ 10,500	50%	$75,000.00	5%	$ 7,500
	STRUCTURAL STEEL - TRUSS MEMBER MODIFICATIONS	EA	92	$60,000.00	$5,520,000.00	37%	$ 2,042,400	34,040.00	7%	$ 386,400	25%	$1,380,000.00	5%	$ 276,000
	STRUCTURAL STEEL - TRUSS GUSSET PLATE MODIFICATIONS	EA	48	$25,000.00	$1,200,000.00	37%	$ 444,000	7,400.00	7%	$ 84,000	25%	$300,000.00	5%	$ 60,000
	STRUCTURAL STEEL - FLOOR BEAM COVER PLATE RETROFITS	EA	54	$10,000.00	$540,000.00	37%	$ 199,800	3,330.00	7%	$ 37,800	25%	$135,000.00	5%	$ 27,000
	STRUCTURAL STEEL - SIDEWALK BRACKETS AND STRINGERS	LB	260,000	$2.00	$520,000.00	37%	$ 192,400	3,206.67	7%	$ 36,400	25%	$130,000.00	5%	$ 26,000
	STRUCTURAL STEEL - ADD STUDS FOR FLOORSYSTEM	EA	16,000	$3.00	$48,000.00	37%	$ 17,760	296.00	7%	$ 3,360	25%	$12,000.00	5%	$ 2,400
	TRUSS - MISCELLANEOUS STEEL REPAIR 1 (SECONDARY MEMBERS)	LS	1	$250,000.00	$250,000.00	37%	$ 92,500	1,541.67	7%	$ 17,500	25%	$62,500.00	5%	$ 12,500
	TRUSS - MISCELLANEOUS STEEL REPAIR 2 (PACK RUST)	LS	1	$250,000.00	$250,000.00	37%	$ 92,500	1,541.67	7%	$ 17,500	25%	$62,500.00	5%	$ 12,500
	TRUSS - MISCELLANEOUS STEEL REPAIR 3 (TBD)	LS	0	$0.00	$0.00	37%	$ -	-	7%	$ -	25%	$0.00	5%	$ -
	TRUSS - MISCELLANEOUS STEEL REPAIR 4 (TBD)	LS	0	$0.00	$0.00	37%	$ -	-	7%	$ -	25%	$0.00	5%	$ -
	ORGANIC ZINC-RICH PAINT SYSTEM - TRUSS	LS	1	$4,000,000.00	$4,000,000.00	50%	$ 2,000,000	33,333	5%	$ 200,000	20%	$800,000	4%	$ 160,000
	WASTE COLLECTION AND DISPOSAL - TRUSS	LS	1	$500,000.00	$500,000.00	12%	$ 60,000	1,000.00	10%	$ 50,000	0%	$0	52%	$ 260,000
	METAL RAILING FOR SIDEWALK (OUTSIDE EDGE)	LF	1,782	$250.00	$445,500.00	12%	$ 53,460	891.00	10%	$ 44,550	0%	$0	52%	$ 231,660
	PIPE RAILING FOR SIDEWALK (INSIDE EDGE)	LF	1,782	$50.00	$89,100.00	12%	$ 10,692	178.20	10%	$ 8,910	0%	$0	52%	$ 46,332
	MODULAR EXPANSION JOINT DEVICES	LF	70	$1,500.00	$105,000.00	12%	$ 12,600	210.00	3%	$ 3,150	57%	$59,850	2%	$ 2,100
	CONDUIT SYSTEM (ELECTRICAL)	EA	1	$10,000.00	$10,000.00	12%	$ 1,200	20.00	3%	$ 300	57%	$5,700	2%	$ 200
	DECK DRAINAGE COLLECTION AND PIPING SYSTEM	EA	1	$50,000.00	$50,000.00	24%	$ 12,000	200.00	5%	$ 2,500	40%	$20,000	5%	$ 2,500
	NAVIGATION LIGHTING SYSTEM REPAIR/REPLACEMENT	LS	1	$50,000.00	$50,000.00	24%	$ 12,000	200.00	5%	$ 2,500	40%	$20,000	5%	$ 2,500
Estimated Total					$16,901,250.00									
Contingency (15%)					$2,535,187.50									
Total Cost Estimate for Option					**$19,436,437.50**									
Base Line Cost-Scenario 1					$ 16,901,250		**$ 6,236,550**	**103,942**		**$ 1,194,984**		**$ 3,619,369**		**$ 1,656,023**

Basis of adjustments
****104,000 MH = 13,000 Man-day @ avg crew of 44 = 300 days**

FIELD OH			PROFIT				
%	$		%	$			
16%	$	80,000	10%	$	50,000		
16%	$	22,800	10%	$	14,250	$ -	100%
16%	$	12,000	10%	$	7,500	$ -	100%
16%	$	4,800	10%	$	3,000	$ -	100%
16%	$	183,904	10%	$	114,940	$ -	100%
16%	$	49,200	10%	$	30,750	$ -	100%
16%	$	17,600	10%	$	11,000	$ -	100%
16%	$	72,000	10%	$	45,000	$ -	100%
16%	$	44,480	10%	$	27,800	$ -	100%
16%	$	21,000	10%	$	13,125	$ -	100%
16%	$	24,000	10%	$	15,000	$ -	100%
16%	$	883,200	10%	$	552,000	$ -	100%
16%	$	192,000	10%	$	120,000	$ -	100%
16%	$	86,400	10%	$	54,000	$ -	100%
16%	$	83,200	10%	$	52,000	$ -	100%
16%	$	7,680	10%	$	4,800	$ -	100%
16%	$	40,000	10%	$	25,000	$ -	100%
16%	$	40,000	10%	$	25,000	$ -	100%
16%	$	-	10%	$	-	$ -	100%
16%	$	-	10%	$	-	$ -	100%
11%	$	440,000	10%	$	400,000	$ -	100%
16%	$	80,000	10%	$	50,000	$ -	100%
16%	$	71,280	10%	$	44,550	$ -	100%
16%	$	14,256	10%	$	8,910	$ -	100%
16%	$	16,800	10%	$	10,500	$ -	100%
16%	$	1,600	10%	$	1,000	$ 0	100%
16%	$	8,000	10%	$	5,000	$ -	100%
16%	$	8,000	10%	$	5,000	$ -	100%

$	**2,504,200**	**$**	**1,690,125**

Direct Cost	$	12,706,925	Total Cost	$	15,211,125
Field OH	$	2,504,200	Profit	$	1,690,125
Equal		19.71%			11.11%

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

Scenario 2, Cost without Contingency **Half width construction-no time restriction**				LABOR @ $60.00/hr			EQUIPMENT		PERM MATLERIAL		EXP MATLERIAL	
				%	$	MH	%	$	%	$	%	$
Labor innefficiency 1/2 width, add material of 25% labor	1.0 hour per man-day @ $60/hr				$ 780,000					$ 150,000		$ 195,000
Equipment Innefiency	300 Hours and $500/hr				$ 18,000			$ 150,000				
Maintain MOT-Labor	8 hour/day x 300 = 2,400 hour @ $60				$ 144,000							$ 10,000
Equipment for MOT	2000 hour @ $40							$ 80,000				
Added MOT-2,500 LF	Barrier rail at $20/ ft in and $8/ft move = $28											$ 70,000
Signal System for One-Way Traffic					$ 40,000							$ 150,000
Maintain Signal Sys 840 mh and 420 Eq Hour					$ 50,400			$ 8,400				$ 25,000
Added and Special Equipment One Lane Work	2000 hour @ $500/hour for equipment + Operator				$ 120,000			$ 100,000				
Add for Change Lanes-new start and finish	Add 2 weeks of work X 44 men = 3,520 MH & 80 Eq				$ 212,000			$ 40,000				
Added hours*OT premium at 20% of hours and $30/hr	22,740	4,548.00	$ 30.00		$ 136,440							
**Added Expendable Material = 10% of Labor add												$ 136,000
					$ 1,364,400			$ 378,400		$ 150,000		$ 450,000
	Field OH		21.62%		$ 294,983			$ 81,810		$ 32,430		$ 97,290
	Total Cost				$ 1,659,383			$ 460,210		$ 182,430		$ 547,290
	Profit		11.11%		$ 184,376			$ 51,134		$ 20,270		$ 60,810
					$ 1,843,759			$ 511,345		$ 202,700		$ 608,100
Total Labor + Equipment + Exp Material					$ 3,165,904							
Base Cost					$ 16,901,250							
Percentage Add					18.73%		USE:	20%				

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

Scenario 3, Cost without Contingency **All work at night 8 hour with full closure-All open in day**					LABOR @ $60.00/hr			EQUIPMENT		PERM MATLERIAL		EXP MATLERIAL	
					%	$	MH	%	$	%	$	%	$
Labor Innefficiency 8 hour only	1.0 hour per man-day @ $60/hr = 13,000 hr					$ 780,000							
Labor innefficiency night	1.0 hour per man-day @ $60/hr					$ 780,000							$ 65,000
Innefficiency of need to open each day	300 days X 1.0 Hour X 44 man-add 25% of labor for material					$ 792,000					$ 150,000		$ 150,000
Labor Closure each night	20 man-hour each day = 500 mh					$ 30,000			$ 10,000				
Added MOT-closure each day													$ 30,000
Added equipment with minimum work hour each day	300 hours @ $500								$ 150,000				
Night time lighting	300 Day X (10 light plant + truck) + Oiler @ 9 hr/day					$ 162,000			$ 270,000				$ 20,000
Added hours*OT premium at 20% of hours and $30/hr	42,400	8,480.00	$	30.00		$ 254,400							
**Added Expendable Material = 10% of Labor add													$ 280,000
						$ 2,798,400			430000		150000		545000
	Field OH			21.62%		$ 605,014			$ 92,966		$ 32,430		$ 117,829
	Total Cost					$ 3,403,414			$ 522,966		$ 182,430		$ 662,829
	Profit			11.11%		$ 378,157			$ 58,107		$ 20,270		$ 73,648
						$ 3,781,571			$ 581,073		$ 202,700		$ 736,477
						$ 5,301,821							
						$ 16,901,250							
						31.37%		USE:	30%				

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

Scenario 4, Cost without Contingency
8-hour night closure-One lane open at night-all open day

			LABOR @ $60.00/hr			EQUIPMENT		PERM MATLERIAL		EXP MATLERIAL	
			%	$	MH	%	$	%	$	%	$
Labor innefficiency 1/2 width, add material of 25% labor	1.0 hour per man-day @ $60/hr			$ 780,000					$ 150,000		$ 195,000
Equipment Innefiency	300 Hours and $500/hr			$ 18,000			$ 150,000				
Maintain MOT-Labor	8 hour/day x 300 = 2400 hour @ $60			$ 144,000							
Equipment for MOT	2000 hour @ $20						$ 40,000				
Added MOT-2,500 LF	Barrier rail at $20/ ft in and $8/ft move = $28										$ 70,000
Signal System for One-Way Traffic				$ 40,000							$ 150,000
Maintain Signal Sys 840 mh and 420 Eq Hour				$ 50,400			$ 8,400				$ 25,000
Labor Innefficiency 8 hour only	1.0 hour per man-day @ $60/hr			$ 780,000							$ 65,000
Labor innefficiency night	1.0 hour per man-day @ $60/hr			$ 600,000							
Innefficiency of need to open each day	300 days X 1.0 Hour X 44 man-add 25% of labor for material			$ 792,000					$ 150,000		$ 150,000
Labor Closure each night	20 man-hour each day = 600 mh			$ 36,000			$ 10,000				$ 3,000
Signal System for One-Way Traffic				$ 40,000							$ 150,000
Maintain Signal Sys 840 mh and 420 Eq Hour				$ 50,400			$ 8,400				$ 25,000
Maintain Signal Sys 840 mh and 420 Eq Hour				$ 50,400			$ 5,000				$ 5,000
Added equipment with minimum work hour each day	250 hours @ $500						$ 125,000				
Night time lighting	300 Day X (10 light plant + truck) + Oiler @ 9 hr/day			$ 162,000			$ 270,000				$ 20,000
Added hours*OT premium at 20% of hours and $30/hr	63,200	12,640.00 $ 30.00		$ 379,200							
**Added Expendable Material = 10% of Labor add											$ 392,000
				$ 3,922,400			$ 616,800		$ 300,000		$ 1,250,000
	Field OH	21.62%		$ 848,023			$ 133,352		$ 64,860		$ 270,250
	Total Cost			$ 4,770,423			$ 750,152		$ 364,860		$ 1,520,250
	Profit	11.11%		$ 530,047			$ 83,350		$ 40,540		$ 168,917
				$ 5,300,470			$ 833,502		$ 405,400		$ 1,689,167

$ 8,228,539
$ 16,901,250
48.69%

USE: 50%

BRIDGE 9040 - REPAIR RECOMMENDATION REPORT COST ESTIMATE

Option: **T4 - Truss Unit - Add sidewalks; Replace deck with lightweight deck; Perform required retrofits**

Scenario 5, Cost without Contingency-No 8 hour restriction
Complete closure at night-One lane closure during day.

				LABOR @ $60.00/hr			EQUIPMENT		PERM MATLERIAL		EXP MATLERIAL	
				%	$	MH	%	$	%	$	%	$
Labor innefficiency 1/2 width, add material of 25% labor-say 50% of 2	1.0 hour per man-day @ $60/hr**50%				$ 390,000					$ 75,000		$ 75,000
Equipment Innefiency	300 Hours and $500/hr							$ 150,000				
Maintain MOT-Labor	8 hour/day x 300 = 2000 hour @ $60				$ 144,000							$ 12,000
Equipment for MOT	2000 hour @ $20							$ 40,000				
Added MOT-2,500 LF	Barrier rail at $20/ ft in and $8/ft move = $28											$ 70,000
Signal System for One-Way Traffic					$ 40,000							$ 150,000
Maintain Signal Sys 840 mh and 420 Eq Hour					$ 50,400			$ 8,400				$ 25,000
Labor innefficiency night	1.0 hour per man-day @ $60/hr				$ 780,000							$ 65,000
Innefficiency of need to open each day	250 days X 1.0 Hour X 40 man-add 25% of labor for material				$ 600,000					$ 150,000		$ 150,000
Labor Closure each night	20 man-hour each day = 600 mh				$ 36,000			$ 10,000				
Added MOT-closure each day												$ 30,000
Added equipment with minimum work hour each day	300 hours @ $500							$ 150,000				
Night time lighting	300 Day X (10 light plant + truck) + Oiler @ 9 hr/day				$ 162,000			$ 270,000				$ 20,000
Added hours*OT premium at 20% of hours and $30/hr	43,000	8,600.00	$ 30.00		$ 258,000							
**Added Expendable Material = 10% of Labor add												$ 246,000
					$ 2,460,400			$ 628,400		$ 225,000		$ 843,000
	Field OH		21.62%		$ 531,938			$ 135,860		$ 48,645		$ 182,257
	Total Cost				$ 2,992,338			$ 764,260		$ 273,645		$ 1,025,257
	Profit		11.11%		$ 332,482			$ 84,918		$ 30,405		$ 113,917
					$ 3,324,821			$ 849,178		$ 304,050		$ 1,139,174
					$ 5,617,222							
					$ 16,901,250							
					33.24%		USE:	35%				

Appendix H

Existing Bridge Plans – Selected Drawings

PVI = 120+67
ELEV. 753.18
V.C. = 1300'
M.O. = 1500

VERTICAL CURVE

B.M. EL. 679.13 (MSL 1929 ADJ.)
TOP OF RIVET IN BRIDGE FOOTING
202' LT. STA. 127+44.00

ELEVATION
SCALE: 1" = 30'-0"

TOP OF ROCK 26' RT.
TOP OF ROCK 20' LT.
ELEV. 659.18
HIGH WATER 681.45 (1952)
NORMAL POOL = 667.40
"ASSUMED LOW WATER"
ELEV. 635.63
ELEV. 647.33
LOW STEEL ELEV. 731.90
MISSISSIPPI RIVER
FLOW
1630'-9 PAVING EXCEPTION

EXP. | FIXED | FIXED | EXP. | FIXED | EXP. | EXP.
72'-0 | 288'-0 | 72'-0
216'-0 SPAN 1 | 432'-0 SPAN 2 | 217'-0 C.C. PIERS SPAN 3
1'-0 | 1'-0

℄ BEARING ABUT. 1
STA. 118+07.00
℄ PIER 1
STA. 120+23.00
℄ PIER 2
STA. 124+55.00
℄ PIER 3
STA. 126+72.00

PIPE DRAIN SPACING
No. OF PIPE DRAINS
C.M.ST.P. & P.R.R.
MINN. | WIS.

STA. 118+04.80
END OF BRIDGE SLAB
FEDERAL NAME PLATE
STATE NAME PLATE
BOX DRAIN SPACING
BM DISK
PG. 737.76
PG. 740.05
PG. 736.01
PG. 723.63
℄ E. ROADWAY & LANE MARKER
STA. 122+99
MANHOLE FOR TELEPHONE CONDUITS SEE SHEET 18 FOR LOCATION AND DETAIL.
2 TELEPHONE CONDUITS UNDER UPSTREAM SIDEWALK. SEE SHEETS 17, 18 & 27
℄ T.H. 63

LIMITS OF RANDOM RIPRAP DERRICK SIZE — SEE SPECIAL PROVISIONS

GENERAL PLAN
SCALE: 1" = 30'-0"

TYPICAL CROSS SECTION
SCALE: 1" = 6'-0"

38'-0
20'-0 CLEAR
3'-8 | 15'-0 | 20'-0 | 15'-0 | 3'-8
2'-6 | 5'-0 | 20'-0 | 5'-0 | 2'-6
¾ IN./FT. | PARABOLIC CROWN | ¾ IN./FT.
PROFILE GRADE
4'-1½ | 7'-11 | 7'-11 | 7'-11 | 7'-11 | 4'-1½
39'-11

GENERAL NOTES:

DESIGN SPECIFICATIONS: AASHO-1953

DESIGN UNIT STRESSES: CONCRETE f_c = 3000 PSI
REINFORCEMENT BARS f_s = 20,000 PSI

	M.H.D. 3305	INTER. MANG. STEEL ◇	M.H.D. 3708
STRUCTURAL STEEL TENSION	18,000 PSI	23,000 PSI	27,000 PSI
AXIAL COMPRESSION	$15{,}000 - \frac{1}{4}(\frac{l}{r})^2$	$18{,}000 - .44(\frac{l}{r})^2$	$22{,}000 - .56(\frac{l}{r})^2$

DESIGN LOADS: AASHO H20-S16

CONSTRUCTION SPECIFICATIONS: THE MINNESOTA DEPARTMENT OF HIGHWAYS "SPECIFICATIONS FOR HIGHWAY CONSTRUCTION" DATED JULY 1, 1947, AND SUBMITTED FOR APPROVAL BY THE DIVISION ENGINEER OF THE BUREAU OF PUBLIC ROADS ON OCT. 15, 1947, AS MODIFIED BY SUPPLEMENT NO. 1 THERETO DATED APRIL 15, 1953, AND SUBMITTED FOR APPROVAL BY THE DIVISION ENGINEER OF THE BUREAU OF PUBLIC ROADS ON MARCH 25, 1953, SHALL GOVERN.

ALL REINFORCEMENT BARS SHALL BE INTERMEDIATE GRADE DEFORMED BARS.
CONCRETE BEARING PADS SHALL BE CAST MONOLITHIC WITH PIER CAPS AND ABUTMENT SEATS.
MATERIAL DESIGNATED ◇ SHALL BE "INTERMEDIATE STRENGTH MANGANESE COPPER BEARING STRUCTURAL STEEL". SEE SPECIAL PROVISIONS.
MATERIAL DESIGNATED ◎ SHALL BE PHOSPHORUS CHROMIUM STEEL, M.H.D. 3303.
STEEL CASTINGS SHALL BE ASTM GRADE 70-36, FULL ANNEALED, M.H.D. 3322.
GIRDER HANGER PINS SHALL BE HOT ROLLED BAR STEEL, M.H.D. 3313.
TRUSS HANGER PINS SHALL BE FORGED STEEL, M.H.D. 3315.
MATERIAL IN ROADWAY JOINTS SHALL BE COPPER BEARING STEEL AS NOTED. M.H.D. 3308.
PINS IN ALL SHOES SHALL BE A.I.S.I. 4140 STEEL.
TRUSS HANGER LINKS SHALL BE Q-T LOW ALLOY STRUCTURAL STEEL.
ALL OTHER STEEL SHALL BE "STRUCTURAL STEEL", M.H.D. 3305.
CONCRETE SEALS FOR PIERS ARE DESIGNED FOR MAX. WATER ELEV. = 670.0'.
MINIMUM ELEV. OF TOP OF COFFERDAM = 671.0'.
ELEVATIONS ARE U.S.G.S. 1929 ADJUSTMENT.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
DATE OCT. 3, 1957 REG. NO. 4671

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO, ILL.

MICRO-FILMED

INDEX OF SHEETS

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TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

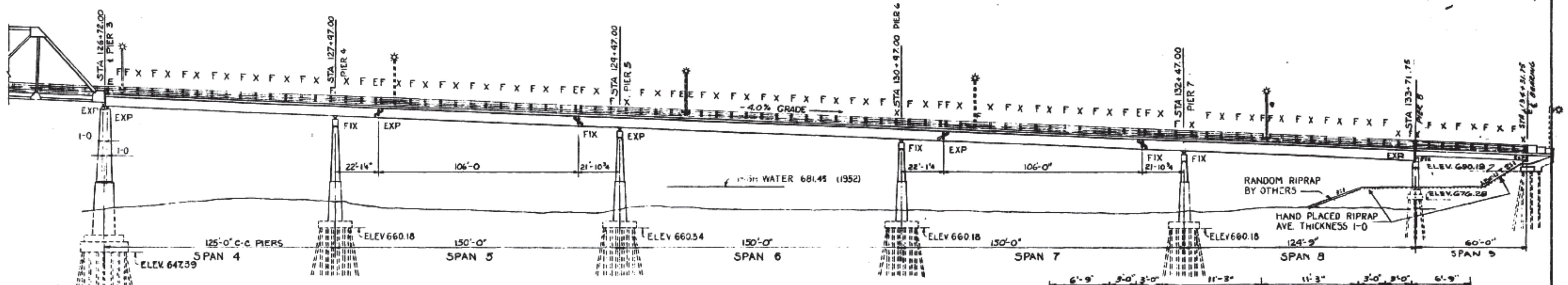
MINN. BRIDGE NO: 9040
OVER MISSISSIPPI RIVER AT RED WING
226'-4 3/8" - 216'-0" TRUSS SPANS
126'-0" - 136'-0" - 140'-0" - 126'-0" PLATE GIRDER SPANS
60' MEAN SPAN - 20' ROADWAY - 2'-2" P.C. SIDEWALKS

GENERAL PLAN & ELEV. TRUSS

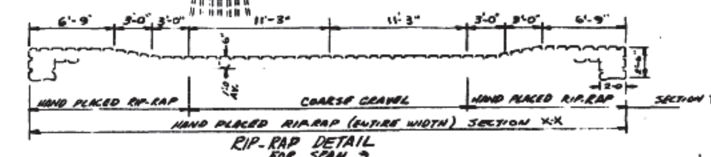
APPROVED: M.V. BLOCK
ENGINEER OF BRIDGES
APPROVED: OCT. 3 1957
STATE ENGINEER
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE ENGINEER
STATE HIGHWAY ENGINEER

MINN. PROJ. F 0551(3) State Proj. No. 2516-02 (T.H. 63=161) SHEET NO. 1 OF 53 SHEETS MINN. BRIDGE NO. 9040 WIS. BRIDGE NO. 8-47-24

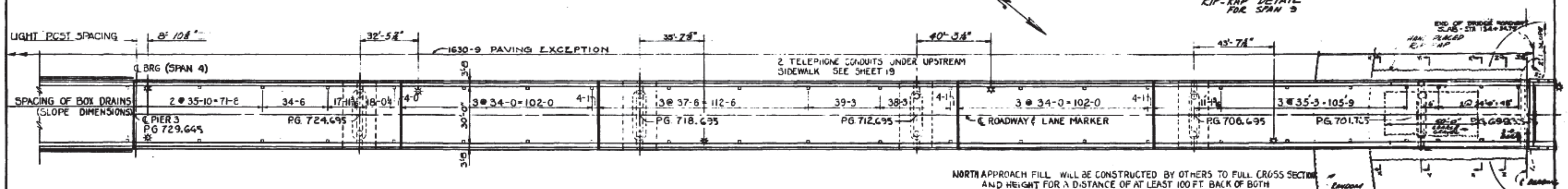
4/16



GENERAL ELEVATION
Scale: 1"=25'



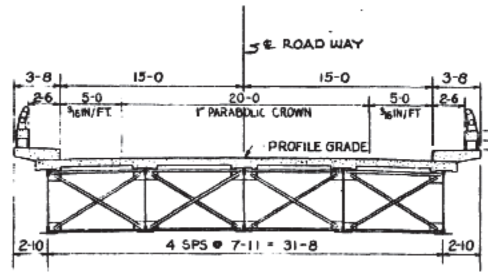
RIP-RAP DETAIL
FOR SPAN 9



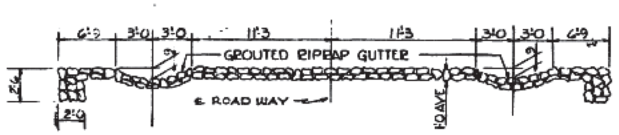
GENERAL PLAN
Scale 1"=25'

NORTH APPROACH FILL WILL BE CONSTRUCTED BY OTHERS TO FULL CROSS SECTION AND HEIGHT FOR A DISTANCE OF AT LEAST 100 FT. BACK OF BOTH ABUTMENTS IN ADVANCE OF BRIDGE CONSTRUCTION.

HAND PLACED RIPRAP WILL BE PLACED BY BRIDGE CONTRACTOR
RIPRAP AT PIER 1 WILL BE PLACED BY BRIDGE CONTRACTOR
OTHER RANDOM RIPRAP TO BE PLACED BY OTHERS.



TYPICAL CROSS SECTION
Scale: 3/16"=1-0



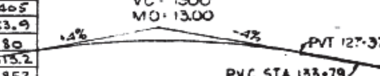
CROSS SECTION THROUGH HAND PLACED RIPRAP
(SECTION Z-Z)

SCHEDULE OF QUANTITIES FOR ENTIRE BRIDGE

FINAL QUANTITIES		ITEM NO.	ITEM	UNIT	QUANTITY
1081.5		2401.521	CLASS DE EXCAVATION	CU. YD.	934
4326.8		2401.522	CLASS WE EXCAVATION	CU. YD.	4044
20		2401.523	CLASS DR EXCAVATION	CU. YD.	26
1302.7		2401.501	CONCRETE MIX NO. 1X1	CU. YD.	1304.2
1264.		2401.501	CONCRETE MIX NO. 1A6	CU. YD.	1261.9
1948.7		2401.501	CONCRETE MIX NO. 3A8	CU. YD.	1950.4
2481.8		2401.501	CONCRETE MIX NO. 3Y6	CU. YD.	2398.3
624483		2401.541	REINFORCEMENT BARS	LB.	619 375
54351		2402.515	STEEL, COPPER BEARING	LB.	48 330
10308		2402.516	STEEL, FORGED	LB.	9800
2545896	*	2402.521	STEEL, STRUCTURAL	LB.	2587700
442 445	*	2402.523	STEEL, STRUCT. PHOSPHORUS CHROME	LB.	427130
875 004	*	402.527	STEEL, INTERMEDIATE STRENGTH MANGANESE COPPER BEARING STRUCTURAL	LB.	877200
5		2402.593	BEARING ASSEMBLIES FIXED (TYPE III)	UNIT	5
3255.4		2402.583	RAILING, ORNAMENTAL, METAL	LIN. FT.	3255
4		2402.593	BEARING ASSEMBLIES FIXED (TYPE I)	UNIT	4
15		2402.593	BEARING ASSEMBLIES FIXED (TYPE II)	UNIT	15
4		2402.594	BEARING ASSEMBLIES, EXP. (TYPE I)	UNIT	4
10		2402.594	BEARING ASSEMBLIES, EXP. (TYPE II)	UNIT	10
5		2402.594	BEARING ASSEMBLIES, EXP. (TYPE III)	UNIT	5
23183	*	402.529	Q-T LOW ALLOY STRUCTURAL STEEL	LB.	16750
5		452.560	STEEL TEST PILES IN PLACE 40' LONG	PILE	5
5		2402.594	BEARING ASSEMBLIES, EXP. (TYPE IV)	UNIT	5

	ITEM NO.	ITEM	UNIT	QUANTITY	FINAL QUANTITIES
	2452.501	UNTREATED TIMBER PILING DELIV	LIN. FT.	29960	40405
	2452.502	UNTREATED TIMBER PILING DRIVEN	LIN. FT.	28624	28153.9
	2452.503	TREATED TIMBER PILING DELIVERED	LIN. FT.	[illegible]	4980
	2452.504	TREATED TIMBER PILING DRIVEN	LIN. FT.	2712	4615.2
	2452.509	STEEL PILING DELIVERED	LB.	170430	185852
	2452.510	STEEL PILING DRIVEN	LIN. FT.	2813	2852.5
	2452.516	UNTREATED TIMBER TEST PILES IN PLACE, 45' LONG	PILE	2	1
	2452.516	UNTREATED TIMBER TEST PILES IN PLACE, 50' LONG	PILE	8	5
	2452.516	UNTREATED TIMBER TEST PILES IN PLACE, 65' LONG	PILE	2	7
	2452.517	TREATED TIMBER TEST PILES IN PLACE, 60'	PILE	2	0
	2452.517	TREATED TIMBER TEST PILES IN PLACE, 75'	PILE	2	0
	2481.501	3-PLY JOINT WATERPROOFING	LIN. FT.	86	86
	2452.517	TREATED TIMBER TEST PILES IN PLACE 90'	PILE	0	2
	2512.501	HAND-PLACED RIPRAP	CU. YD.	150	188.4
	2511.501	RANDOM RIPRAP	CU. YD.	153	168.2
	2402.577	PLATES, STANDARD NAME	UNIT	3	3
	2432.502	ELECTRIC LIGHTING SYSTEM	SYSTEM	1	1
*	402.580	LUBRICATED BUSHINGS TYPE 1	UNIT	16	16
*	402.580	LUBRICATED BUSHINGS TYPE 2	UNIT	38	38
	2461.501	CONCRETE, GRADE Y, MIX NO. 3Y6	CU. YD.	136.7	137.1

* SEE SPECIAL PROVISIONS



VERTICAL CURVE

MICRO-FILMED

TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

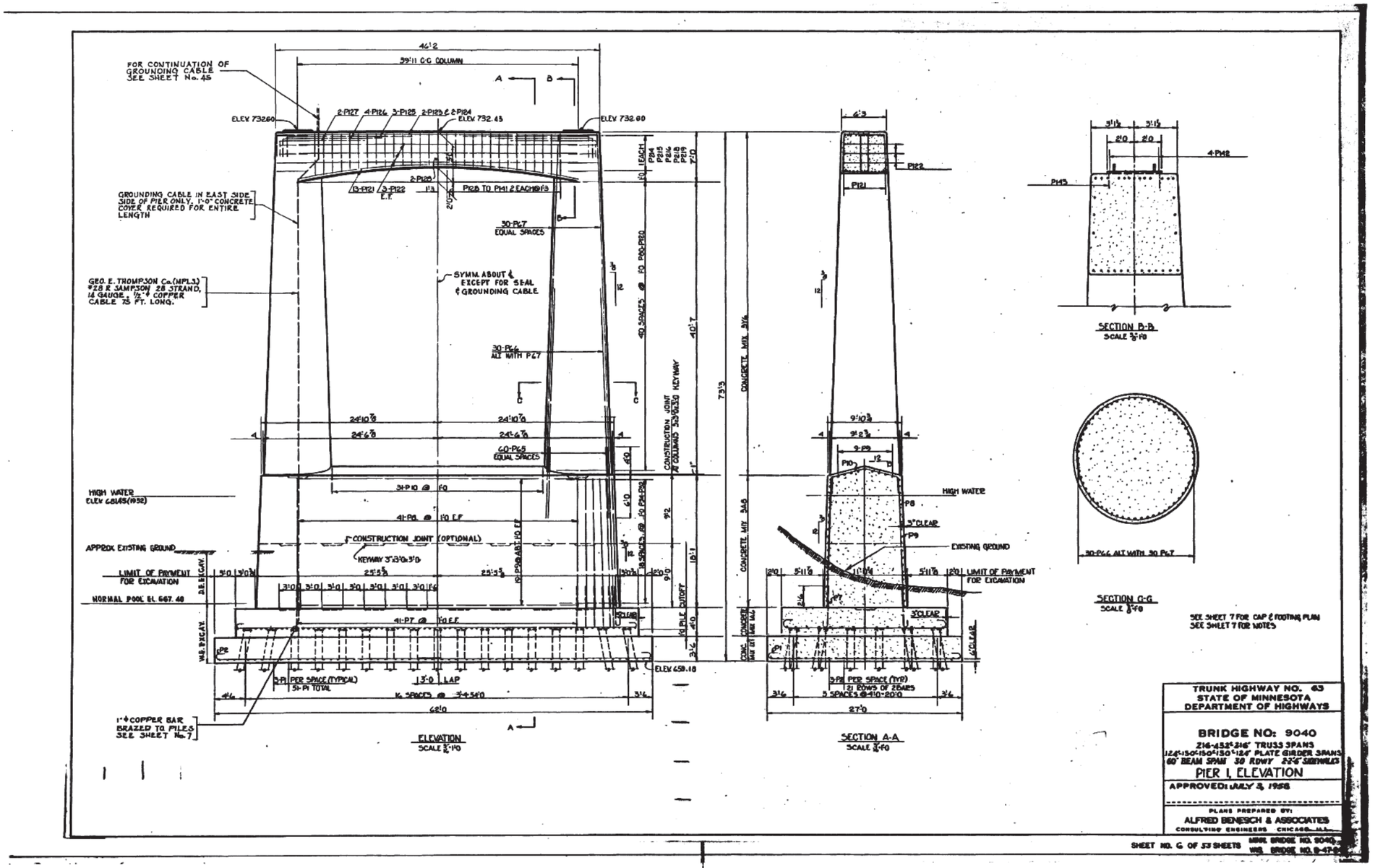
BRIDGE NO: 9040
OVER MISSISSIPPI RIVER AT RED WING

GEN. PLAN & ELEV.-APPROACH GIRDERS

APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

MINN. PROJ. F 055-1(1) SHEET NO. 2 OF 53 SHEETS MINN. BRIDGE NO. 9040



TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040

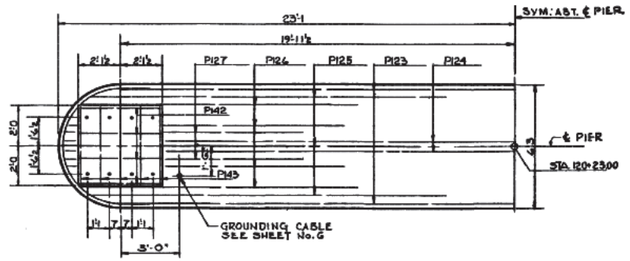
216'-4 3/2"-216' TRUSS SPANS
124'-150'-150'-150'-124' PLATE GIRDER SPANS
60' BEAM SPAN 30' ROWY 22'6" SIDEWALKS

PIER 1, ELEVATION

APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO, ILL.

SHEET NO. 6 OF 53 SHEETS MINN. BRIDGE NO. 9040
WIS. BRIDGE NO. B-47-

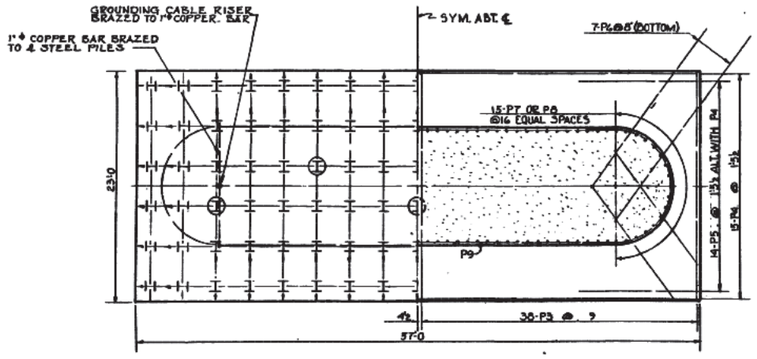


PART PIER CAP PLAN - PIER 1
SCALE 3/8"=1'0

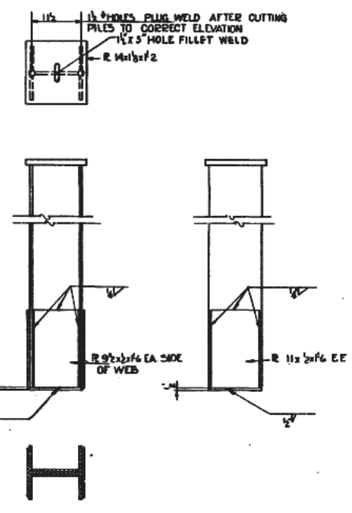
* SUMMARY OF QUANTITIES FOR PIERS 1 TO 7

	DESCRIPTION	UNIT	PIER 1	PIER 2	PIER 3	PIER 4	PIER 5	PIER 6	PIER 7	TOTAL
	CLASS DE EXCAVATION	CU YD	232	—	132	200	52	55	30	701
	CLASS WE EXCAVATION	CU YD	510	1480	1204	219	214	219	198	4044
✚	CONCRETE MIX 1X1	CU YD	215.6	780.0	308.6	—	—	—	—	1304.2
✚	CONCRETE MIX 1A6	CU YD	193.1	519.7	158.6	84.7	84.7	84.7	72.7	1198.2
	CONCRETE MIX 3A8	CU YD	345.1	686.4	476.6	123.6	114.6	106.3	97.8	1950.4
	CONCRETE MIX 3Y6	CU YD	214.2	194.1	140.0	45.2	37.0	30.5	24.8	685.8
	REINFORCEMENT BARS	LB.	67800	84500	40580	21840	20010	18100	18050	270680
○ △	UNTREATED TIMBER PILING, DELIV.	LIN. FT	—	14410	4830	2800	2800	2800	2320	29960
○ △	UNTREATED TIMBER PILING, DRIVEN	LIN. FT	—	13886	4554	2660	2660	2660	2204	28624
△ ✱	STEEL PILING, DELIVERED	LB.	170430	—	—	—	—	—	—	170430
△	STEEL PILING, DRIVEN	LIN. FT	2815	—	—	—	—	—	—	2815
○	UNTREATED TIMBER TEST PILES IN PLACE, 45' LONG	PILE	—	—	2	—	—	—	—	2
○	UNTREATED TIMBER TEST PILES IN PLACE, 50' LONG	PILE	—	—	—	2	2	2	2	8
○	UNTREATED TIMBER TEST PILES IN PLACE, 65' LONG	PILE	—	2	—	—	—	—	—	2
	STEEL, STRUCTURAL	LB.	—	1300	—	—	—	—	—	1300
x	STEEL TEST PILES IN PLACE 40' LONG	PILES	5							5

* FOR QUANTITIES FOR PIER 8 SEE SH. 50
◆ CONCRETE DISPLACED BY TIMBER PILES HAS BEEN DEDUCTED AT RATE OF 0.8 CU. FT. PER LIN. FT. OF EMBEDDED LENGTH
✱ INCLUDES WEIGHT OF CAP & TIP REINFORCEMENT.
x SEE SPECIAL PROVISIONS
△ EXCLUSIVE OF TEST PILES
○ SEE CONSTRUCTION PILE REPORTS



FOOTING PLAN PIER 1
SCALE 3/8"=1'0



PILE REINFORCEMENT DETAIL
SCALE 1"=1'0

PILE NOTES

97 STEEL PILES (12BP53) REQD ESTIMATED LENGTH 30 FT.
5-STEEL TEST PILES (12BP53) REQD ESTIMATED LENGTH 40 FT AND INDICATED IN PLAN BY (X)
TOTAL 102-STEEL PILES (12BP53) REQD. FOR PIER #1
ESTIMATED PILE PENETRATION 1FT LESS THAN LENGTH GIVEN.
PILES MARKED H-TO BE BATTERED 2 IN PER FT. IN DIRECTION INDICATED BY ARROW.
MIN. BEARING ON ALL PILES 50 TONS PER PILE.
COMPUTED DEAD LOAD = 35.4 TONS PER PILE
COMPUTED DEAD LOAD + LIVE LOAD = 39.5 TONS PER PILE.

NOTES

CONCRETE PROTECTION OVER REINFORCEMENT SHALL BE 2 IN UNLESS NOTED.
ANCHOR BOLTS SHALL BE DRILLED IN AND GROUTED.
SEE SHEET 15&16 FOR REINFORCEMENT SCHEDULE.
BARS IN TOP OF CAP BEAM TO BE CAREFULLY PLACED TO CLEAR ANCHOR BOLTS.
PILES SHALL BE DRIVEN TO REFUSAL IN SOUND ROCK.

TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

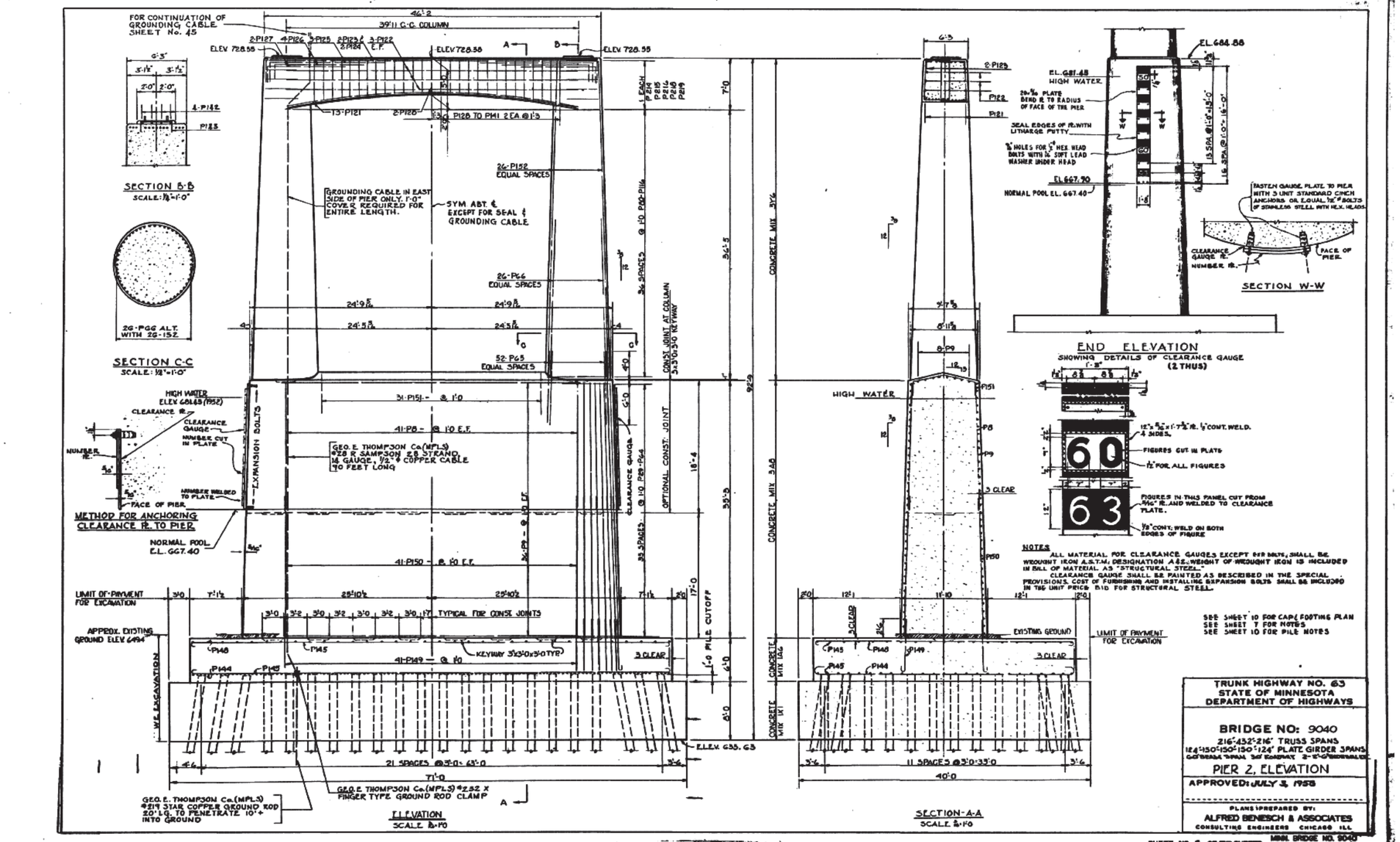
BRIDGE NO: 9040
216'-432'-216' TRUSS SPANS
124'-130'-130'-130'-124' PLATE GIRDER SPANS
60' BEAM SPAN 30' R'WAY 2'-6" SIDEWALKS

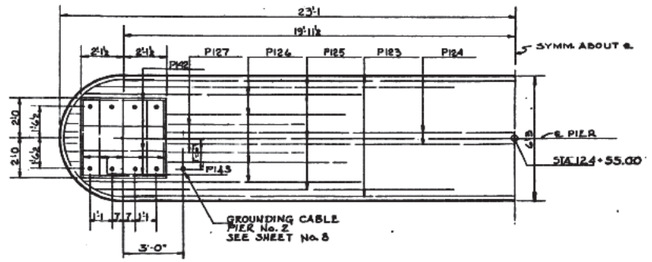
PIER 1 PLAN

APPROVED: JULY 3, 1958

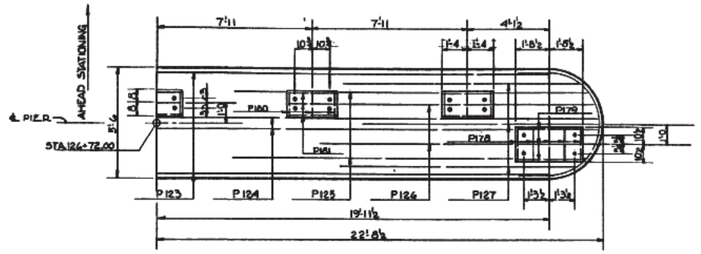
PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

SHEET NO. 7 OF 53 SHEETS MINN. BRIDGE NO. 9040 WIS. BRIDGE NO. B-17-26

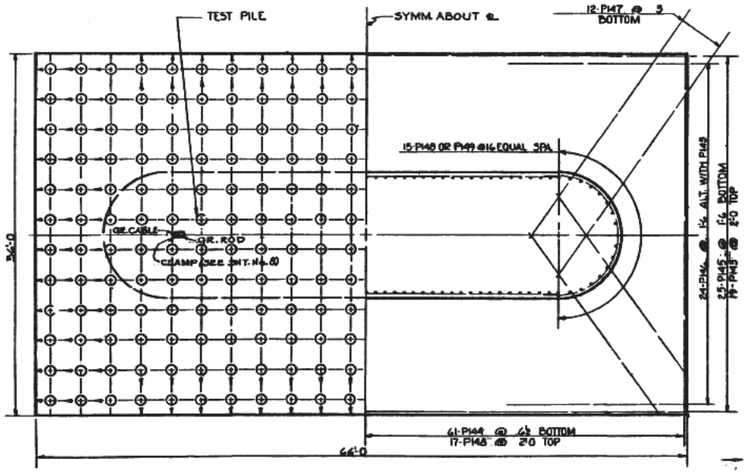

FOR CONTINUATION OF GROUNDING CABLE SEE SHEET No. 45
46'-2
39'-11 C-C COLUMN
ELEV 728.55
ELEV 728.38
13-P121
2-P128
P128 TO PH1 2 EA @ 1'-3
26-P152 EQUAL SPACES
GROUNDING CABLE IN EAST SIDE OF PIER ONLY. 1'-0" COVER REQUIRED FOR ENTIRE LENGTH.
SYM ABT. ℄ EXCEPT FOR SEAL & GROUNDING CABLE
26-P66 EQUAL SPACES
52-P65 EQUAL SPACES
31-P151 - @ 1'-0
41-P8 - @ 10 E.F.
GEO. E. THOMPSON Co.(MPLS) #28 E SAMPSON 7 STRAND 14 GAUGE, 1/2" COPPER CABLE 70 FEET LONG
41-P150 - @ 10 E.F.
41-P149 - @ 10
KEYWAY 3'X3'-0"X3'-0" TYP.
TYPICAL PIER CONST. JOINTS
21 SPACES @ 3'-0" = 63'-0
71'-0
ELEV 635.63
CONST. JOINT AT COLUMN 3'X3'-0"X3'-0" KEYWAY
OPTIONAL CONST. JOINT
CONCRETE MIX 3Y6
CONCRETE MIX 3A6
CONCRETE MIX 1A6
CONCRETE MIX 1X1
1-0 PILE CUTOFF
EXPANSION BOLTS
CLEARANCE GAUGE @ 10 P68-P84
35 SPACES @ 10 P68-P84
LIMIT OF PAYMENT FOR EXCAVATION
APPROX. EXISTING GROUND ELEV 649.4
W.P. EXCAVATION
EXISTING GROUND
3 CLEAR
11 SPACES @ 3'-0" = 33'-0
40'-0
ELEVATION
SCALE 1/8"=1'-0
SECTION-A-A
SCALE 1/8"=1'-0
SECTION B-B
SCALE: 1/8"=1'-0"
SECTION C-C
SCALE: 1/8"=1'-0"
26-P66 ALT. WITH 26-152
HIGH WATER ELEV 684.65 (1952)
CLEARANCE ℞
CLEARANCE GAUGE
NUMBER CUT IN PLATE
NUMBER WELDED TO PLATE
FACE OF PIER
METHOD FOR ANCHORING CLEARANCE ℞. TO PIER
NORMAL POOL EL. 667.40
GEO. E. THOMPSON Co.(MPLS) #219 STAR COPPER GROUND ROD 20'-0 LG. TO PENETRATE 10'+ INTO GROUND
GEO. E. THOMPSON Co.(MPLS) #2.32 X FINGER TYPE GROUND ROD CLAMP
HIGH WATER
EL. 684.88
EL. 681.48 HIGH WATER
20-3/8" PLATE BEND R TO RADIUS OF FACE OF THE PIER
SEAL EDGES OF ℞ WITH LITHARGE PUTTY
7/8" HOLES FOR 1" HEX HEAD BOLTS WITH 1/2" SHT LEAD WASHER UNDER HEAD
EL. 667.90
NORMAL POOL EL. 667.40
FASTEN GAUGE PLATE TO PIER WITH 3 UNIT STANDARD CINCH ANCHORS OR EQUAL 7/8" ϕ BOLTS OF STAINLESS STEEL WITH HEX. HEADS
CLEARANCE GAUGE ℞ NUMBER 18
FACE OF PIER
SECTION W-W
END ELEVATION
SHOWING DETAILS OF CLEARANCE GAUGE (2 THUS)
12"x 5/16"x 1'-7 1/2" ℞. 1/8" CONT. WELD. 4 INDES.
FIGURES CUT IN PLATE
1/2" FOR ALL FIGURES
FIGURES IN THIS PANEL CUT FROM 3/16" ℞. AND WELDED TO CLEARANCE PLATE.
3/8" CONT. WELD ON BOTH EDGES OF FIGURE
NOTES
ALL MATERIAL FOR CLEARANCE GAUGES EXCEPT PER BOLTS, SHALL BE WROUGHT IRON A.S.T.M. DESIGNATION A 82. WEIGHT OF WROUGHT IRON IS INCLUDED IN BILL OF MATERIAL AS "STRUCTURAL STEEL."
CLEARANCE GAUGE SHALL BE PAINTED AS DESCRIBED IN THE SPECIAL PROVISIONS. COST OF FURNISHING AND INSTALLING EXPANSION BOLTS SHALL BE INCLUDED IN THE UNIT PRICE BID FOR STRUCTURAL STEEL.
SEE SHEET 10 FOR CAP & FOOTING PLAN
SEE SHEET 7 FOR NOTES
SEE SHEET 10 FOR PILE NOTES
TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE NO: 9040
216'-432'-216' TRUSS SPANS
124'-150'-150'-150'-124' PLATE GIRDER SPANS
PIER 2, ELEVATION
APPROVED: JULY 3, 1958
PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.
SHEET NO. 8 OF 63 SHEETS
MINN. BRIDGE NO. 9040
WIS. BRIDGE NO. B-47-24



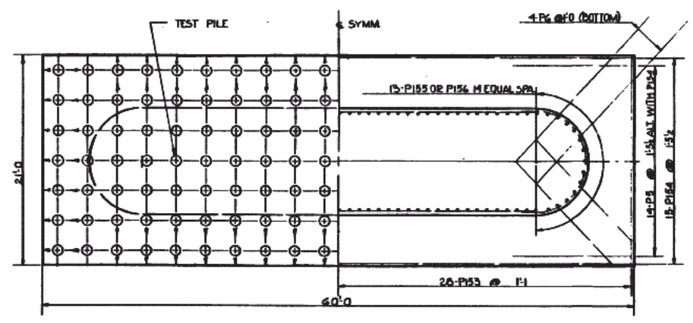
PART PIER CAP PLAN - PIER 2
SCALE ⅜"=1'0



PART PIER CAP PLAN - PIER 3
SCALE ⅜"=1'0



FOOTING PLAN - PIER 2
SCALE ⅛"=1'0



FOOTING PLAN - PIER 3
SCALE ⅛"=1'0

NOTES

PIER 2

- 2 UNTREATED TIMBER TEST PILES REQ'D 65 FT. LONG.
- 262 UNTREATED TIMBER PILES REQ'D- ESTIMATED LENGTH 55 FT.
- 264 UNTREATED TIMBER PILES REQ'D FOR PIER 2.
  COMPUTED DEAD LOAD = 15.4 TONS PER PILE.
  COMPUTED DEAD LOAD + LIVE LOAD = 19.9 TONS PER PILE.

PIER 3

- 2 UNTREATED TIMBER TEST PILES REQ'D 45 FT. LONG.
- 136 UNTREATED TIMBER PILES REQ'D- ESTIMATED LENGTH 35 FT.
- 140 UNTREATED TIMBER PILES REQ'D FOR PIER 3.
  COMPUTED DEAD LOAD = 18.7 TONS PER PILE.
  COMPUTED DEAD LOAD + LIVE LOAD = 20 TONS PER PILE.

ESTIMATED PILE PENETRATION 2' LESS THAN LENGTH GIVEN.
PILES MARKED O— TO BE BATTERED 2 IN. PER FT. IN DIRECTION INDICATED BY ARROW.
MIN. BEARING ON ALL PILES - 20 TONS PER PILE.
SEE SHEET 7 FOR ADDITIONAL NOTES.
CONCRETE DISPLACED BY TIMBER PILES HAS BEEN DEDUCTED AT RATE OF 0.8 CU. FT. PER LIN. FT. OF EMBEDDED LENGTH
O SEE CONSTRUCTION PILE REPORTS

TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040

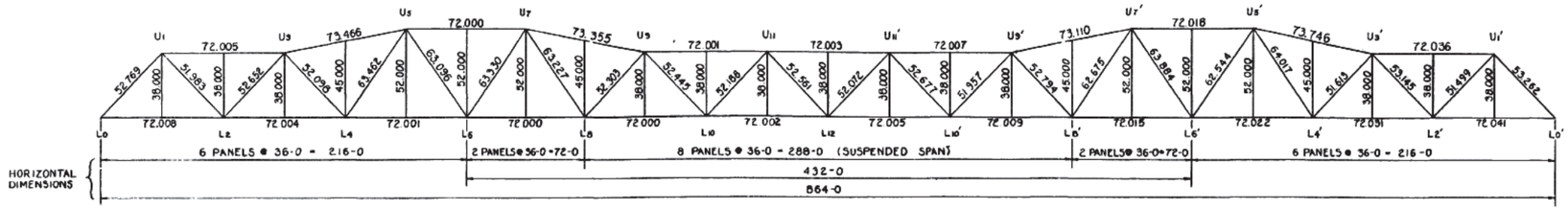
216'-4B2½216" TRUSS SPANS
124'-150'-150'-130'-124' PLATE GIRDER SPANS
30' REAM SPAN 30' ROAD 2'-2½" SIDE WALKS

PIERS 2 & 3, PLAN

APPROVED: JULY 3, 1958

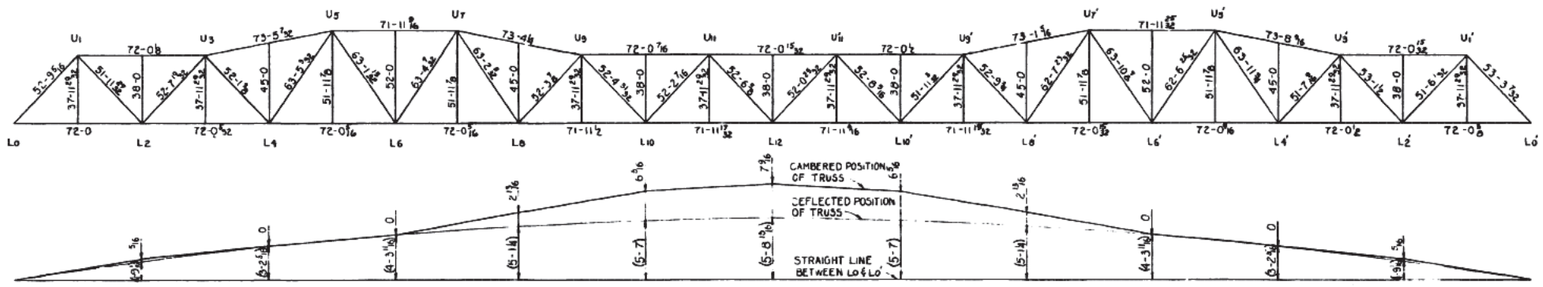
PLANS PREPARED BY
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO, ILL.

SHEET NO. 10 OF 53 SHEETS MNH. BRIDGE NO. 9040 WIS. BRIDGE NO. 0-57-04



TRUSS LAYOUT

SHOWING DIMENSIONS IN FEET
CORRECTIONS FOR SHOP CAMBER NOT INCLUDED



FABRICATED LENGTHS
CAMBER BLOCKING ORDINATES

No Scale

VALUES SHOWN THUS (5-1¼) ARE ORDINATES TO VERTICAL CURVE

NOTES:

CAMBER
TRUSSES SHALL BE CAMBERED FOR FULL DEAD LOAD STRESSES AS SHOWN ABOVE FROM DETAILED SHOP DRAWINGS TO GIVE EXACT GEOMETRY AT 45°F.

ERECTION SCHEME
THE CONTRACTOR SHALL SUBMIT FOR APPROVAL A COMPLETLY DETAILED ANALYSIS OF THE ERECTION SCHEME PROPOSED WITH PROPER PROVISION FOR ALL CONTINGENCIES AT EVERY STAGE OF ERECTION

ANY ADDITIONAL MATERIAL OR CHANGES IN MATERIAL TYPE REQUIRED BY THE CONTRACTORS METHOD OF ERECTION SHALL BE AT THE CONTRACTOR'S EXPENSE. TEMPORARY ERECTION MEMBERS AND DETAILS SHALL BE REMOVED MAINTAINING THE GEOMETRY OF THE STRUCTURE.

DRAIN HOLES
WIDE FLANGE SECTIONS FORMING HORIZONTAL OR NEARLY HORIZONTAL TROUGHS AND OTHER POINTS WHERE WATER MAY COLLECT SHALL BE ADEQUATELY DRAINED DRAIN HOLES WHERE INDICATED ON THE TYPICAL DETAILS SHALL BE USED. DRAIN HOLES SHALL BE LOCATED ON DETAILS WITH DUE REGARD TO MAINTAINING DESIGNED NET SECTIONS OF MEMBERS.

ALTERNATING STRESSES
AS PROVIDED IN A.A.S.H.O. SPECIFICATIONS EXCEPT THAT 90 PER CENT OF THE MINIMUM DEAD LOAD STRESS SHALL BE CONSIDERED EFFECTIVE IN COUNTERACTING LIVE LOAD STRESSES.

SHOP ASSEMBLY OF TRUSSES
THE TRUSSES SHALL BE ASSEMBLED FOR REAMING IN TRUE GEOMETRICAL POSITION. THE TRUSSES SHALL BE COMPLETELY ASSEMBLED IN SECTIONS L0-L8, L8-L8' & L8'-L0' BEFORE REAMING. ALL PARTS REAMED ASSEMBLED SHALL BE MATCHMARKED ALL FLOORBEAM CONNECTIONS SHALL BE REAMED TO METAL TEMPLATES

ALL RIVETS ⅞ ϕ AND ALL HOLES 15/16 ϕ UNLESS NOTED 1 ϕ RIVETS SHALL HAVE 1 1/16 ϕ HOLES. ¾ ϕ BOLTS SHALL HAVE 13/16 ϕ HOLES. STRINGER DIAPHRAGM AND BRACING CONNECTIONS MAY BE PUNCHED FULL SIZE EXCEPT WHERE METAL IS MORE THAN ¾ INCH THICK OR WHERE THERE ARE MORE THAN 5 THICKNESSES OF METAL, OR WHERE CONNECTED TO MAIN TRUSS MEMBERS. SEE MHD 2471

PAINT NOTES

SHOP COAT	- RED LEAD	MHD 3506
1ST FIELD COAT	- GRAY	MHD 3522
2ND FIELD COAT	- ALUMINUM	MHD 3527

TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040

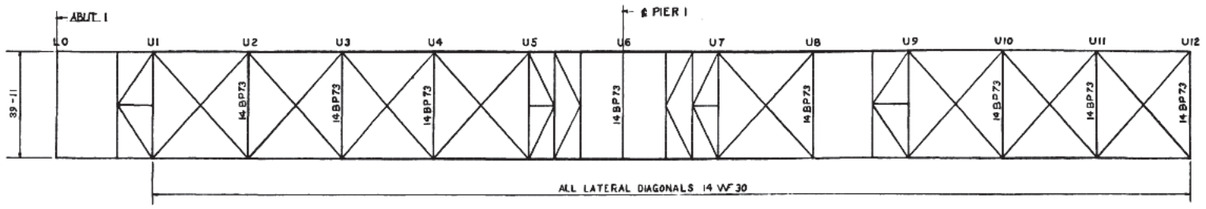
216'-432'-216' TRUSS SPANS
124'-150'-150'-124' PLATE GIRDER SPANS
60' BEAM SPAN 30' ROWY 2-2'6" SIDEWALKS

TRUSS LAYOUT

APPROVED: JULY 3, 1958

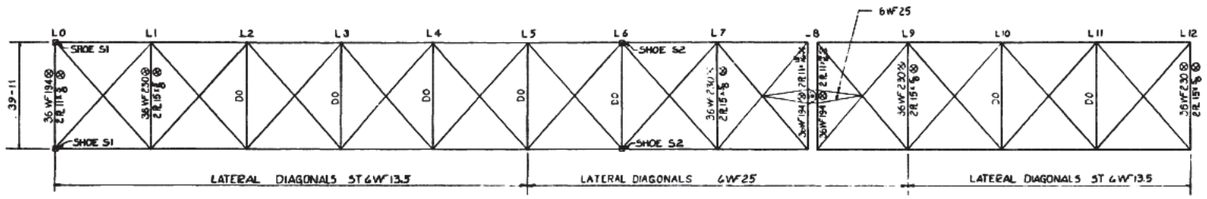
PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

SHEET NO. 24 OF 53 SHEETS MINN. BRIDGE NO. 9040 WIS. BRIDGE NO. B-47-24



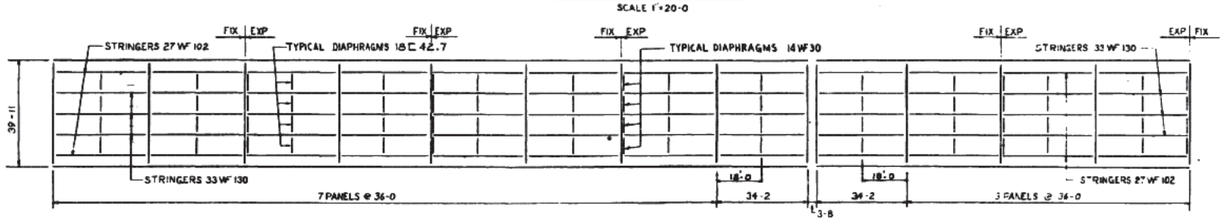
PLAN-TOP LATERAL SYSTEM

SCALE 1"=20'-0



PLAN-BOTTOM LATERALS

SCALE 1"=20'-0

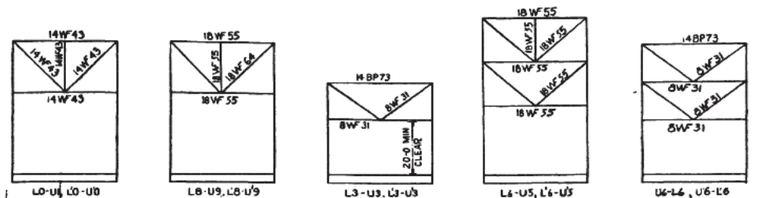


FRAMING PLAN-FLOOR STEEL

SCALE 1"=20'-0

MAXIMUM TRUSS REACTION

	DL	LL	I	S.W	TOTAL
R0	146	107	16	12	281
R6	1460	315	38	36	1849
R8	536	133	14	15	698



ELEVATION OF PORTALS & SWAY FRAME

STRESS TABLE - STRINGERS & FLOOR BEAMS

MEMBER	MOMENT - FT KIPS D	L	I	S.W	TOTAL	REACTION-KIPS D	L	I	S.W	TOTAL	SECTION
THREE INTERIOR STRINGERS	167	300	90	—	557	18.6	48.2	12.7	—	79.5	33WF130
TWO EXTERIOR STRINGERS	209	122	37	25	393	23.2	17.1	5.1	2.7	48.1	27WF102
FLOOR BEAM @ Lo4 U6	535	800	240	10	1585	54.7	60.1	18.0	2.7	135.5	36WF194+2 PL 1"x 8"-0
FLOOR BEAM @ L6 U6	597	814	244	10	1665	59.2	61.3	18.3	2.7	141.5	36WF194+2 PL 1¼"x 8"-0
INTERIOR FLOOR BEAM	1031	844	253	25	2151	104.9	63.5	19.2	5.4	193.0	36WF230+2 PL 5/8"x 27'-0
FLOOR BEAM Lo to U6 DL+JACKING	512	—	—	—	512	146	—	—	—	146.0	36WF194+2 PL 1¼"x 27'-0

TRUNK HIGHWAY NO. 65
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040.

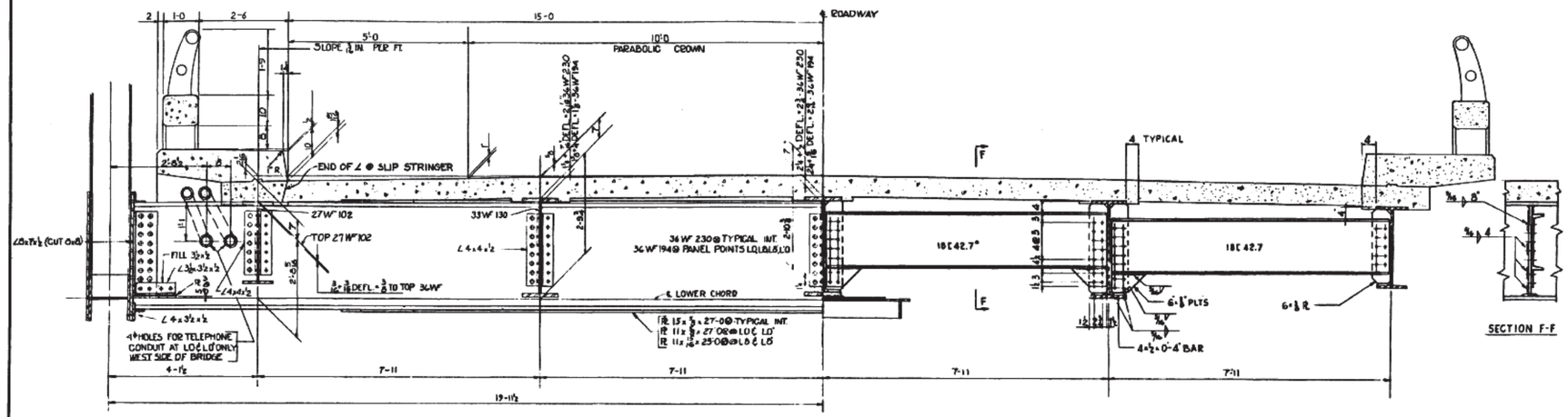
216'-432'-216' TRUSS SPANS
124'-150'-150'-150'-124' PLATE GIRDER SPANS
60' BEAM SPAN 30' ROADWAY 2-2'6" SIDEWALKS

TRUSS FRAMING PLAN

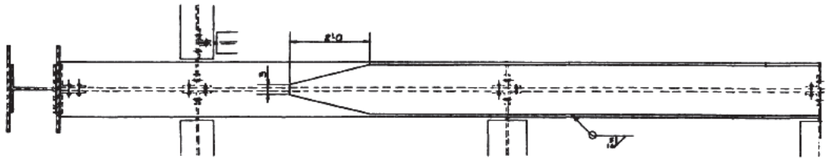
APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

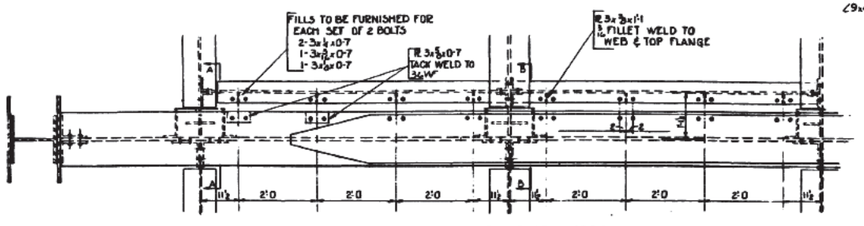
SHEET NO. 26 OF 53 SHEETS MINN. BRIDGE NO. 9040
WIS. BRIDGE NO. 8-47-24



FLOOR BEAMS
SCALE ¾"=1'0

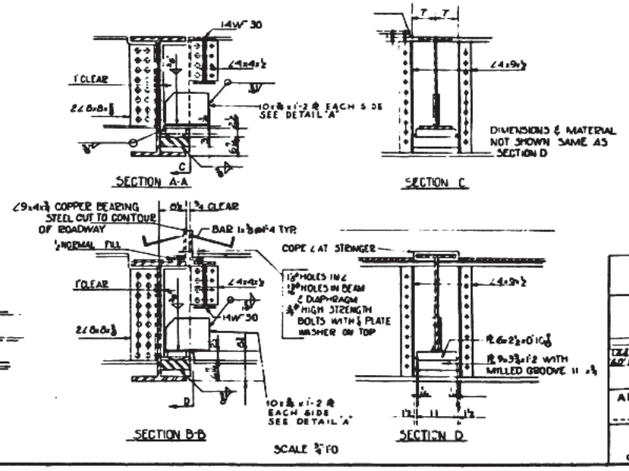


COVER PLATE AT FLOOR BEAM
SCALE ¾"=1'0



PLAN OF FLOOR BEAM AT SLIP STRINGERS
SCALE ¾"=1'0

INTERIOR CROSS SECTION



NOTES
1. MATERIAL DESIGNATED @ SHALL BE INTERMEDIATE STRENGTH MANGANESE COPPER BEARING STRUCTURAL STEEL.
2. ALL OTHER STEEL SHALL BE STRUCTURAL STEEL M.H.D. 3305 UNLESS NOTED.
3. ALL RIVETS ⅞" IN 15/16" OPEN HOLES UNLESS NOTED.

TRUNK HIGHWAY NO. 65
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO. 9040

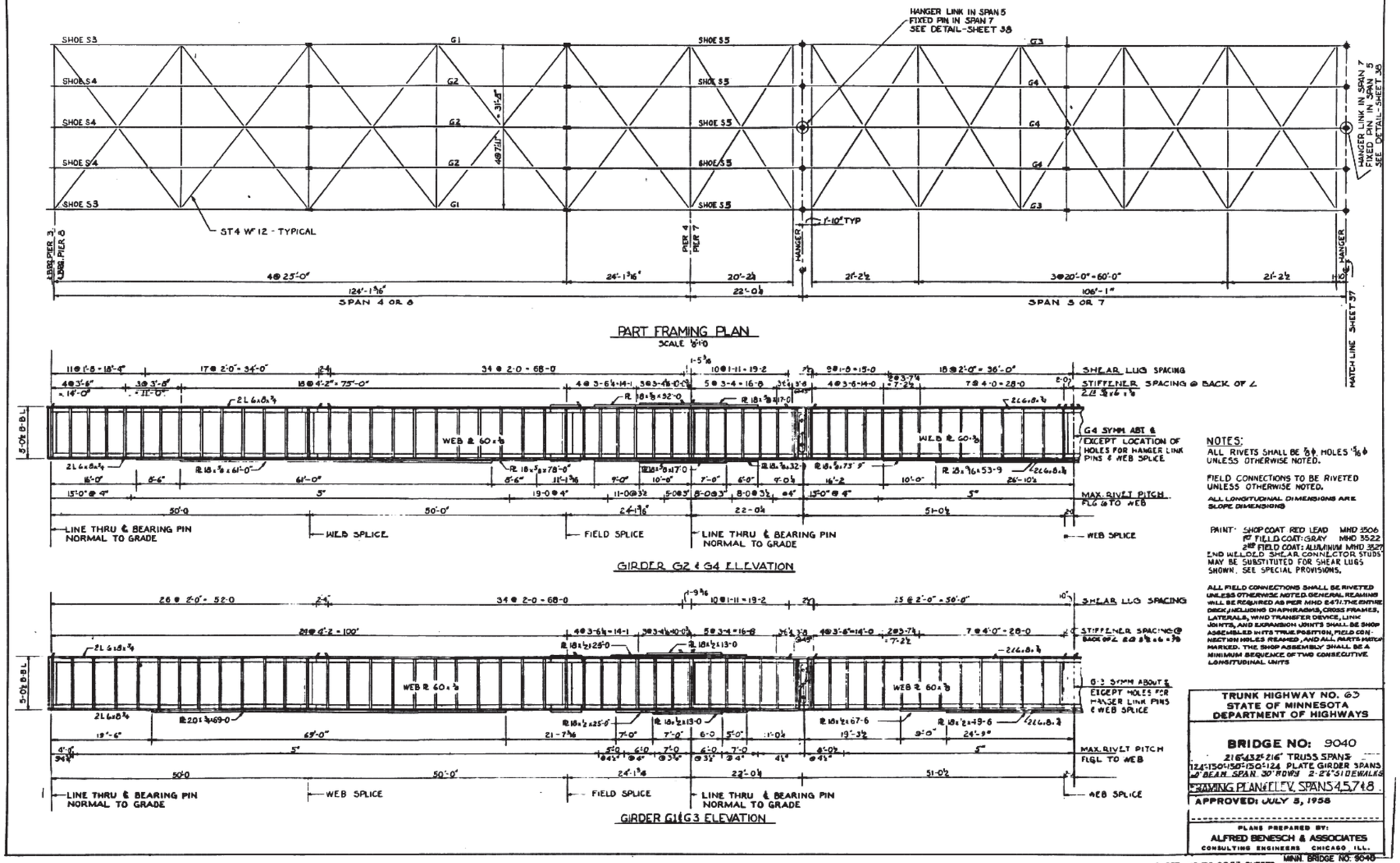
216'-252'-216' TRUSS SPANS
124'-150'-150'-124' PLATE GIRDER SPANS
40' BEAM SPAN, 36' ROWY, 2-2'6" SIDEWALKS

TRUSS FLOOR DETAILS

APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

SHEET NO. 27 OF 53 SHEETS MINN. BRIDGE NO. 9040
WIS. BRIDGE NO. B-47-24



NOTES:

ALL RIVETS SHALL BE 7/8 ϕ, HOLES 15/16 ϕ UNLESS OTHERWISE NOTED.

FIELD CONNECTIONS TO BE RIVETED UNLESS OTHERWISE NOTED.

ALL LONGITUDINAL DIMENSIONS ARE SLOPE DIMENSIONS

PAINT: SHOP COAT RED LEAD MND 3506
1ST FIELD COAT: GRAY MND 3522
2ND FIELD COAT: ALUMINUM MND 3527

END WELDED SHEAR CONNECTOR STUDS MAY BE SUBSTITUTED FOR SHEAR LUGS SHOWN. SEE SPECIAL PROVISIONS.

ALL FIELD CONNECTIONS SHALL BE RIVETED UNLESS OTHERWISE NOTED. GENERAL REAMING WILL BE REQUIRED AS PER MND 2471. THE ENTIRE DECK, INCLUDING DIAPHRAGMS, CROSS FRAMES, LATERALS, WIND TRANSFER DEVICE, LINK JOINTS, AND EXPANSION JOINTS SHALL BE SHOP ASSEMBLED IN ITS TRUE POSITION, FIELD CONNECTION HOLES REAMED, AND ALL PARTS MATCH MARKED. THE SHOP ASSEMBLY SHALL BE A MINIMUM SEQUENCE OF TWO CONSECUTIVE LONGITUDINAL UNITS

TRUNK HIGHWAY NO. 65
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040

216'-132'-216' TRUSS SPANS
124'-150'-150'-150'-124' PLATE GIRDER SPANS
40' BEAM SPAN 30' ROWS 2-26'-3" SIDEWALKS

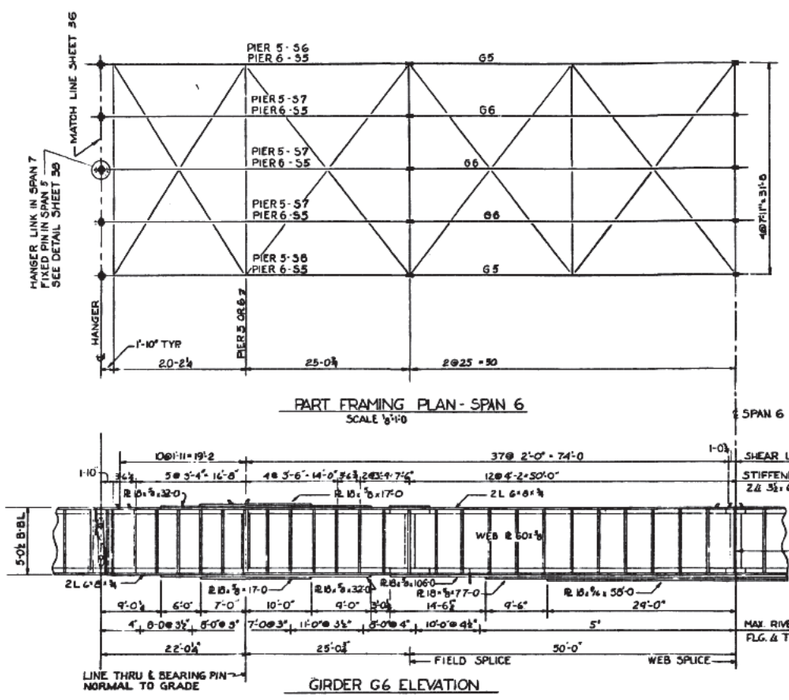
FRAMING PLAN & ELEV. SPANS 4, 5, 7 & 8

APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO, ILL.

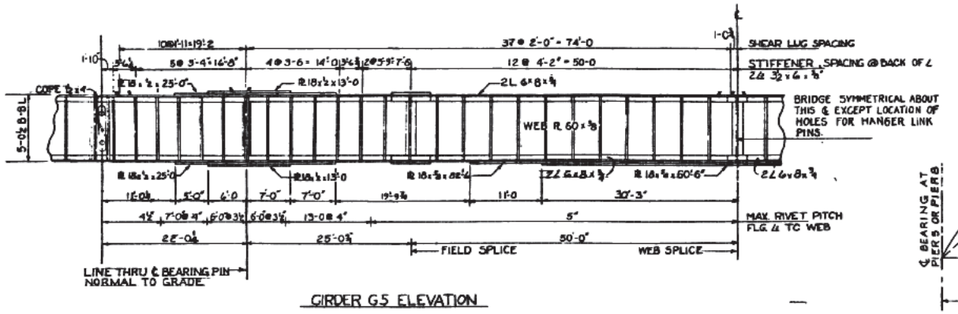
SHEET NO. 36 OF 53 SHEETS

MINN. BRIDGE NO. 9040
WIS. BRIDGE NO. B-47-24

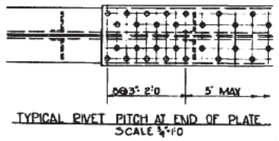


PART FRAMING PLAN - SPAN 6
SCALE 1/8"=1'0

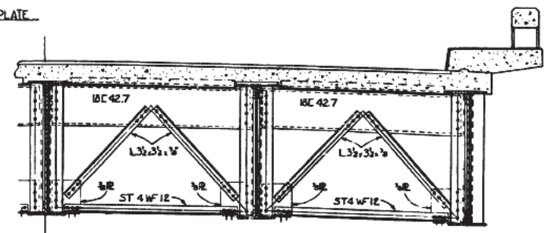
GIRDER G6 ELEVATION



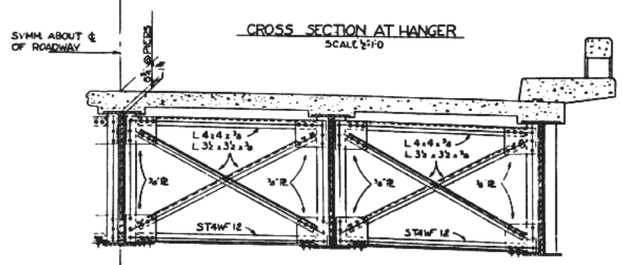
GIRDER G5 ELEVATION



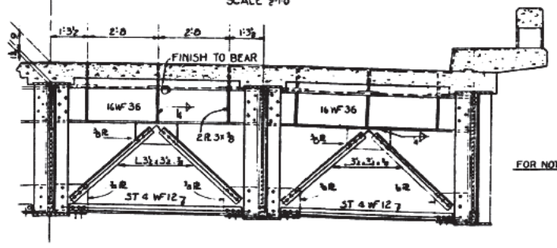
TYPICAL RIVET PITCH AT END OF PLATE
SCALE ¾"=1'0



CROSS SECTION AT HANGER
SCALE ½"=1'0

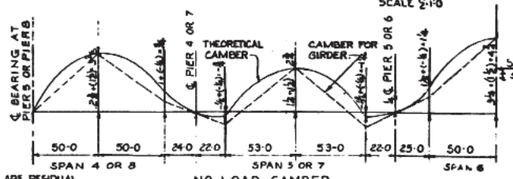


INTERIOR CROSS SECTION
SCALE ½"=1'0



FOR NOTES SEE SHEET 36

CROSS SECTION AT PIER 3 ℄ 8
SCALE ½"=1'0



NO LOAD CAMBER

VALUES SHOWN THUS (½) ARE RESIDUAL CAMBER AFTER ALL DEAD LOAD HAS BEEN APPLIED

TRUNK HIGHWAY NO. 63
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

BRIDGE NO: 9040

216'-432'-216' TRUSS SPANS
124'-150'-150'-124' PLATE GIRDER SPANS
36' REAR SPAN 32' ROADWAY 2-2'-6" SIDEWALKS

FRAMING PLAN & ELEV. SPANS 5, 6, 7

APPROVED: JULY 3, 1958

PLANS PREPARED BY:
ALFRED BENESCH & ASSOCIATES
CONSULTING ENGINEERS CHICAGO ILL.

SHEET NO. 37 OF 53 SHEETS MINN. BRIDGE NO. 9040 WIS. BRIDGE NO. B-47-24