



Rope Access Climbing Bridge Inspection Report

Asset #: 03719

Bridge #: L32101000+01001

District: Missoula

Location: Maclay Truss Bridge over Bitterroot River

Inspected: June 14th, 2019

Prepared for:



Prepared by:

**COLLINS
ENGINEERS** INC.

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1.0 INTRODUCTION

The Maclay Truss Bridge, Asset No. 03719, was inspected June 14th, 2019 by Collins Engineers, Inc. for the Montana Department of Transportation. The point of contact for this inspection at the Maclay Truss Bridge in Missoula County was Charles Horinek at 406-444-6470. This 377 ft long 4 span bridge was originally constructed in 1935 and includes a 180 ft. through truss, a 39 ft. pony truss, and two concrete girder spans. The bridge was stationed from west to east. The main truss panel points were labeled L0 – L4 – L0' and the pony truss panel points were labeled L0 – L3 – L0' both from west to east. The substructure units were labeled Abutment 1, Bents 2-4, and Abutment 5, from west to east. Refer to Photographs in SMS for overall views of the bridge and approaches, and all defects.

The purpose of this fracture critical climbing inspection was to identify the condition and structural deficiencies of the bridge with emphasis on the fracture critical members. Refer to Appendix A for a diagram identifying the fracture critical members on this bridge, as well as bridge nomenclature used for documentation purposes. The inspection consisted of an above water inspection using various rope access climbing techniques to obtain a visual examination of all the structural components of the bridge at a distance no greater than arm's length. Refer to Appendix C for detailed fracture critical inspection procedures.

The inspection team consisted of four members led by an MDT approved fracture critical inspection Team Leader. All team members were certified by the Society of Professional Rope Access Technicians (SPRAT) to safely perform rope access work. The engineer climbers used a two-rope system in accordance with SPRAT guidelines.

2.0 INSPECTION FINDINGS

2.1 Deck

The concrete deck was in fair condition. The one lane bridge carried both eastbound and westbound North Ave W. traffic. Both edges of the bridge deck were lined with guardrails and pedestrian rails.

The asphalt wearing surface covered the deck and exhibited minor wear throughout. Refer to the following table for the location and description of specific wearing surface deficiencies:

<u>Location</u>	<u>Description</u>
Span 1	The end 6 ft. by full bridge width adjacent to the West Approach had a cold patch with minor wear and hairline map cracking.
Span 1	Transverse cracking up to 1/8 in. wide by full width spaced approximately 20 ft. apart at floor beam locations with delamination in asphalt patches.
Span 1	Approximately 1 percent of the wearing surface had been repaired with cold patches that had map cracking up to 1/8 in. wide.
Span 1 at FB3'	Area of longitudinal and transverse cracking above Stringer 3 at FB3' with 90–100 percent section loss and multiple holes in an area measuring 18 in. long by 12 in. wide and associated cracking in the corrugated forms in the area surrounding the holes measuring 30 in. long by 24 in. wide.
Span 1 at FB2'	Area of longitudinal and transverse cracking above Stringer 6 at FB2' with a hole measuring 2 in. in diameter and associated cracking in the corrugated forms extending 1 ft. to the east and west of the hole.
Span 3	Transverse crack up to 1/2 in. wide located above Bent 4.
Span 4	Transverse crack up to 3/4 in. wide located above Abutment 5.

Table 1: Deck and Wearing Surface Specific Defects

The underside of the deck was in fair condition. The underside of Spans 1 and 2 consisted of galvanized, corrugated stay-in-place formwork that had welding burn through holes throughout with minor surface corrosion and negligible section loss to the burn hole edges. The welding burn through holes allowed debris to fall through the stay-in-place formwork onto the floor beams. The underside of the deck in Spans 3 and 4 consisted of top flanges of tee beams with isolated areas of efflorescence seeping through the construction joints and superficial cracking, but no notable deficiencies.

Roadway joints were located at Abutment 1 and Bents 2 and 3. The joint over Abutment 1 consisted of 11 ft. long by 30 in. wide metal plate bolted to the bridge deck on the east side of the joint. The joint over Bent 2 was an open joint. The joint over Bent 3 was a compression joint. Refer to the following table for the location and description of specific joint deficiencies:

<u>Location</u>	<u>Description</u>
Bent 2	Joint edge had (2) 3/4 in. bends over a 1 ft. section in the south wheel path.
Bent 3	The rubber seal had failed in 90 percent of its length.
Bent 3	Joint had separated from Span 2 header over a 4 ft. length.
Bent 3	Joint edge had a 1/2 in. bend over a 6 in. length in the south wheel path.

Table 2: Bridge Joint Specific Defects

Expansion joint measurements were taken on the south edges of the deck. All measurements were taken at 85° F. See *Table 3* below for the measurements.

<u>Location</u>	<u>Measurement</u>
Bent 2, South Rail	7/16 in.
Bent 3, South Rail	Fully Compressed

Table 3: Deck Expansion Joint Measurements

2.2 Superstructure

2.2.1 Floor Beams

The painted steel floor beams were in good condition. The floor beams in Spans 1 and 2 were numbered corresponding with the truss panel points. The floor beams were steel rolled beam sections connected to the lower chord by a pinned connection. The floor beams typically exhibited a loss of protective coating on approximately 40 percent of their surface area with minor surface corrosion and no loss of section on the exposed areas, 40 percent of the surface protective coating had failed with exposed primer underneath, and the remaining painted coating was bubbling and peeling. The bottom west flange of Floor Beam 1' on Span 1 exhibited an upwards deflection of 1/2 in. over a 6 in. length approximately 16 in. from the north end.

2.2.2 Stringers

The stringers were typically in poor condition. For documentation purposes, the stringers were numbered 1 through 8 from the north to the south. Approximately 90 percent of the stringers were painted, while other 10 percent were replaced with unpainted steel stringers. Approximately 30 percent of the painted coating on the stringers had failed with moderate corrosion with up to 1/16 in. thick rust scale, 15 percent had failed with exposed primer underneath, and the remaining painted coating was bubbling and peeling. 20 percent of the stringers that were left unpainted and had minor to moderate corrosion with negligible section loss. The stringer ends at Abutment 1, Bent 2, and Bent 3 had debris accumulation on top of the abutment seat and bent caps, and around the ends of the stringer webs and bottom flanges. The inspectors cleaned the debris from around the stringer ends for inspection. Refer to the following table for the locations and descriptions of specific stringer defects.

Span	Bent/FB	Stringer	Defect Description
1	1	2	The stringer web exhibited heavy corrosion and section loss over a 14 in. long by 2 in. high area with a 2.5 in. long by ¾ in. high hole 2 in. from the stringer end.
1	1	5	The stringer web exhibited heavy corrosion and up to 50 percent section loss over a 10 in. long by 1 in. high section adjacent to the stringer end.
1	1	7	The stringer web exhibited heavy corrosion and section loss over a 17 in. long by 2 in. high area with a 1 in. high by 10 in. long hole 10 in. from the stringer end.
1	FB3	5	(2) of 2 bolts were loose at the stringer to floor beam connection.
1	FB3'	1	(2) of 2 bolts were loose at the stringer to floor beam connection.
1	FB1'	8	Stringer 8 from FB2' to FB1' was rotated to the north approximately 1 in. at FB1'.
2	2	2	The stringer web exhibited heavy corrosion and section loss with (2) holes; 10 in. long by 1.5 in. high and 6 in. long by 1 in. high centered 16 in. from the stringer end.
2	2	5	The stringer web exhibited a 16 in. long by 2 in. high area of delamination up to ¼ in. thick on the bottom of the south face located 12 in. from the end of the stringer.
2	3	All	The hollow pipe on which the stringers were bearing moved up to ¼ in. when vehicles passed over. The south anchor rod for the south pipe was broken and this edge of the pipe exhibited vertical movement up to ½ in.
2	3	2	The stringer web exhibited heavy corrosion with up to 1/8 in. thick rust scale on both sides of the stringer web at the web to lower flange interface adjacent to the stringer end.
2	3	5	The stringer web exhibited heavy corrosion and section loss with a 6 in. long by 1 in. high through hole near the stringer end. The bottom flange was knife edged in this area.

2	3	4,5,7	A gap was noted between the bottom flange and the hollow bearing pipe at Bent 3. Movement of the stringers was observed when traffic passed over this area (gap closed).
2	3	7	The stringer web had heavy corrosion with up to 50 percent section loss over a 10 in. long by 2 in. high area adjacent to the stringer end that had a 1/2 in. diameter hole 6 in. from the stringer end at the web to lower flange interface.
2	3	8	The stringer web exhibited heavy corrosion and section loss with three through holes ranging in size from 1/4 in. to 1/2 in. diameter located at the web to lower flange interface at the stringer end.

Table 4: Stringer Specific Defects

2.2.3 Precast Concrete T-Beams

The concrete T-beams of Spans 3 and 4 were in good condition. The joints between beams in Span 3 exhibited efflorescence with light build up and some light rust staining. No other significant defects were noted.

2.2.4 Bearings

The bearings and bearing assemblies were in fair condition. Roller bearings were located at Abutment 1. Fixed bearings were located at Bent 2. Sliding bearings were located at Bent 3. At the time of the inspection the temperature was 85° F.

The North and South Truss roller bearings at Abutment 1 exhibited a failed painted coating on approximately 25 percent of the surface area with moderate corrosion and pitting up to 1/16 in. to the steel underneath, 10 percent had failed with exposed primer underneath, and the remaining paint was chalking. There was heavy corrosion under the rollers and roller keepers. The roller keepers had split due to heavy corrosion and the nested roller assemblies had failed.

The North Truss roller bearing at Abutment 1 had two rollers along with a portion of the keeper that had worked out from underneath the truss to the west of the bearing and one roller was sticking out from underneath the bearing to the east of the bearing. The anchor rods exhibited up to 25 percent section loss at the concrete interface due to heavy corrosion. The top plate was displaced 1-3/4 in. to the west (in expansion) in relation to the bottom plate.

The South Truss roller bearing keeper at Abutment 1 had broken away from the bearing due to heavy corrosion and was pushed against the abutment backwall. Half of the rollers were still within the bearing but were not fully in contact with the bearing plates. The top plate was displaced 1-1/2 in. to the west (in expansion) in relation to the bottom plate.

The North and South Truss fixed bearings at Bent 2 of both Spans 1 and 2 exhibited a failed painted coating on approximately 5 percent of the surface area with minor surface corrosion and negligible section loss, 10 percent had failed with exposed primer underneath, and the remaining painted coating was chalking.

The North and South Truss sliding bearings at Bent 3 were unpainted and had moderate corrosion with pitting up to 1/16 in. deep. The top plates were displaced 1-1/2 in. at the north bearing and 1-7/8 in. at the south bearing to the east (in expansion) in relation to the upper flanges of the bearings.

2.2.5 Truss

The lower chord typically exhibited approximately 15 percent loss of coating with moderate corrosion and negligible loss of section on the exposed areas, 25 percent had failed with exposed primer underneath, and the remaining painted coating was bubbling and peeling.

The remaining truss members were in fair condition. Approximately 5 percent of the painted coating on truss members had failed with minor surface corrosion and negligible section loss, 5 percent had failed with exposed primer underneath, 5 percent was chalking, and the remaining painted coating was in good condition.

Refer to the following table for locations and descriptions of specific truss member deficiencies:

<u>Member/ Location</u>	<u>Span</u>	<u>Truss</u>	<u>Defect Description</u>
L1-U1	1	North	Exterior flange of vertical was bent 1 in. to the north due to impact damage approximately 5 ft. above the bridge deck.
U2	1	South	(1) loose bolt at upper horizontal strut to top chord connection plate.
U4	1	South	(1) loose and (1) sheared off bolt on horizontal strut to top chord connection plate.
U3'	1	North/South	Lower horizontal sway brace member was bent 2 in. to the east and upward and downward 1 in. due to impact damage.

U2'	1	North	(2) loose bolts at upper horizontal strut connection.
L2'-U2'	2	North	Vertical interior flange bent 1 in. over 6 in. height due to impact damage.
L2'-U1'	2	North	Interior flange bent 1-3/8 in. over 24 in. length due to impact damage.
L2'-U1'	2	South	Diagonal bent 3/4 in. over 12 in. at L4.
U1'	2	North	Exterior gusset plate had (2) misdrilled 3/4 in. diameter holes.
U1'-L0'	2	North	(7) areas of impact damage up to 3/4 in. long and 1/4 in. deflection spaced over 15 in. length.

Table 5: Truss Member Specific Defects

2.3 Substructure

The abutments were in satisfactory condition and constructed of reinforced concrete. Abutment 1 exhibited one full height vertical crack up to 1/8 in. wide in the middle of the abutment. Abutment 1 exhibited rust staining under the truss due to corrosion from the steel members above. Abutment 2 had no notable deficiencies.

Bent 2 exhibited random hairline temperature and shrinkage cracking over its entire surface area. The west elevation had seven areas of delamination up to 60 in. wide by 12 in. high. The east elevation had five areas of delamination up to 15 in. high by 30 in. wide. The edges of the delaminations exhibited spalling up to 1 in. penetration with no exposed reinforcing.

Bent 3 exhibited random hairline map cracking throughout its surface area with minor efflorescence build-up in random, isolated areas. The top, southeast corner of the bent had a 12 in. wide by 10 in. high area of delamination. The northeast corner of the bent exhibited a 5 ft. long horizontal crack up to 1/16 in. wide located near the bottom.

Bent 4 exhibited a 3 ft. wide by 2 ft. high spall with exposed reinforcing steel on the west face of the bent cap. The exposed reinforcing steel had moderate corrosion with negligible section loss.

2.4 Concrete Approach Slabs

The asphalt paved approach roadways were in satisfactory condition. No settlement was noted between either approach and the bridge deck. Refer to the following table for the location and description of approach deficiencies.

<u>Location</u>	<u>Defect Description</u>
West Approach	Sound cold patch measuring 5 ft. long by bridge width with no noted cracking.
West Transition	Full width transverse cracks up to 1/4 in. wide approximately 18 ft. from west transition.

Table 6: Concrete Approach Specific Defects

2.5 Miscellaneous

A 5-1/2 in. high by 8 in. wide reinforced concrete curb lines both sides of Spans 3 and 4. The curb was in poor condition. The north concrete curb on Span 4 exhibited section loss up to 1-1/2 in. on the top and interior faces with no exposed reinforcing steel. The north curb exhibited an area of spalling over Bent 4 measuring 4 ft. long by full width and height with exposed longitudinal and stirrup reinforcing steel. The utility pipe on the north side of the bridge was broken for a 1 ft. length at Floor Beam 4.

The bridge railings in Spans 1 and 2 were 14 in. high and constructed of a 6 in by 6 in. galvanized steel tube. There was a 42 in. high pedestrian rail behind each bridge rail constructed of three steel angles which were attached to the truss verticals with plates. The pedestrian railing exhibited failure of approximately 50 percent of the painted coating with minor surface corrosion and negligible section loss, 20 percent had failed with exposed primer, 10 percent was bubbling and peeling, and the remaining coating was in good condition. The vertical angle on the south rail in Span 1 between Panel Points 4' and 3' was bent 1-1/2 in. over a 2 ft. length due to impact damage. The bottom angle on the north rail in Span 1 at Panel Point 1' was bent 3/4 in. upwards.

The bridge rails in Spans 3 and 4 were constructed of a 6 in. diameter top rail, a 12 in. tall W-beam mid rail and a 5 in. vertical steel plate at the bridge deck. All parts of the railing had a painted coating. Approximately 5 percent of the painted coating exhibited failure with minor surface corrosion and negligible section loss primarily on the vertical steel plate at the bridge deck, 5 percent had failed with exposed primer,

and the remaining painted coating was in good condition. Three vertical members had impact damage that bent the interior flange 3/4 in. over a 6 in. length with gouging on the north rail near the east approach. The top rail was bent downward 1-1/2 in. over a 5 ft. length on the east end of the south rail.

3.0 CONCLUSION

3.1 NBI Ratings

Overall, the Maclay Truss Bridge was in fair condition. This rating is based on the above water condition of the bridge only. The Deck rating changed from 6 to 4 due to full penetration holes in Span 1. Refer to the following table for the NBI ratings based on the completed climbing/routine inspection:

<u>NBI Item</u>	<u>NBI Description</u>	<u>NBI Rating Previous</u>	<u>NBI Rating New</u>
58	Deck	6	4
59	Superstructure	5	5
60	Substructure	5	5
61	Channel	7	7

Table 7: NBI Ratings

This structure was posted for a 11-ton load. For this bridge, SMS list the Type 3 Truck Inventory Rating at 11-ton. As such, NBI Item (41) Structure Open, Posted, or Closed to Traffic should remain coded “P – Posted for Load”.

3.2 Recommendations

Based on the current inspection findings, Collins does not recommend review of the load rating.

3.3 Underwater Inspection Recommendations

The NBI rating for substructure is based on the above water condition of the bridge. At the time of inspection, the water depth and current prohibited safe access to Bent 4 due to the spring runoff. Therefore, Collins recommends an underwater Type I inspection be performed, MDT061 Type I Underwater Inspection Required was confirmed as “Y.” and item 92B-1 was confirmed as “N”.

3.4 Maintenance Recommendations

Maintenance recommendations are detailed in SMS.

The above report summarizes our inspection findings for Bridge 03719 over the Bitterroot River. Per FHWA regulations, fracture critical bridges are to be inspected at intervals not to exceed 24 months. If you have any questions or concerns regarding the content of this report, please do not hesitate to contact me.

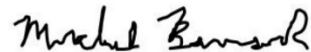
Respectfully Submitted,

COLLINS ENGINEERS, INC.



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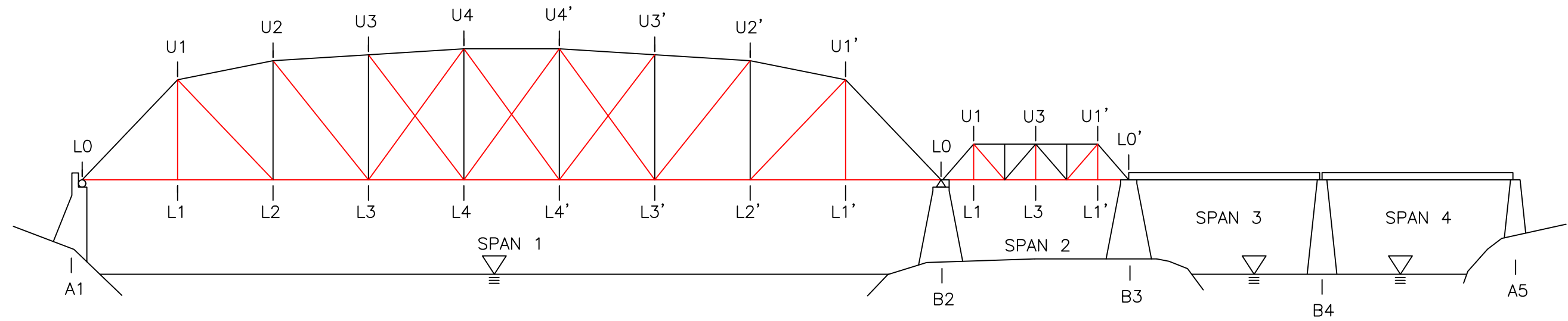
APPENDIX A – Fracture Critical Member Diagram and Defect Sketches



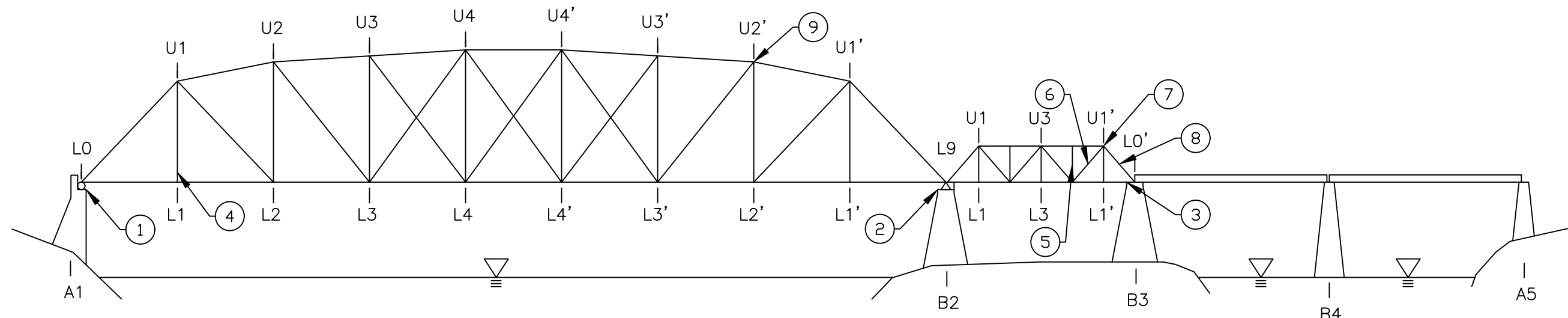
Fracture Critical Member Diagram
 MacLay Bridge
 Asset # 03719, Bridge # L32101000+01001
 Missoula, MT

CEI PROJECT
 11696-25
 INSPECTED BY:
 MJB
 DRAWN BY:
 NWW
 CHECKED BY:
 DRG
 DATE:
 6-14-2019
 SHEET NO:
A-1

△ — FIXED BEARING
 ○ — MOVEABLE BEARING
 MEMBERS HIGHLIGHTED IN RED ARE FRACTURE CRITICAL
 ALL (10) FLOOR BEAMS ARE ALSO FRACTURE CRITICAL



① ELEVATION LOOKING NORTH



② NORTH TRUSS LOOKING NORTH

GENERAL NOTES:

- a. APPROXIMATELY 5 PERCENT OF THE PAINTED COATING HAD FAILED ON THE VERTICALS, UPPER CHORD, AND DIAGONAL MEMBERS WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 5 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, 5 PERCENT WAS CHALKING, AND THE REMAINING PAINTED COATING WAS IN GOOD CONDITION.
- b. APPROXIMATELY 15 PERCENT OF THE PAINTED COATING HAD FAILED ON THE LOWER CHORD WITH MODERATE CORROSION WITH NEGLIGIBLE SECTION LOSS, 25 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING.
- c. APPROXIMATELY 40 PERCENT OF THE PAINTED COATING ON THE BRACING HAD FAILED WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 40 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING.

SPECIFIC NOTES:

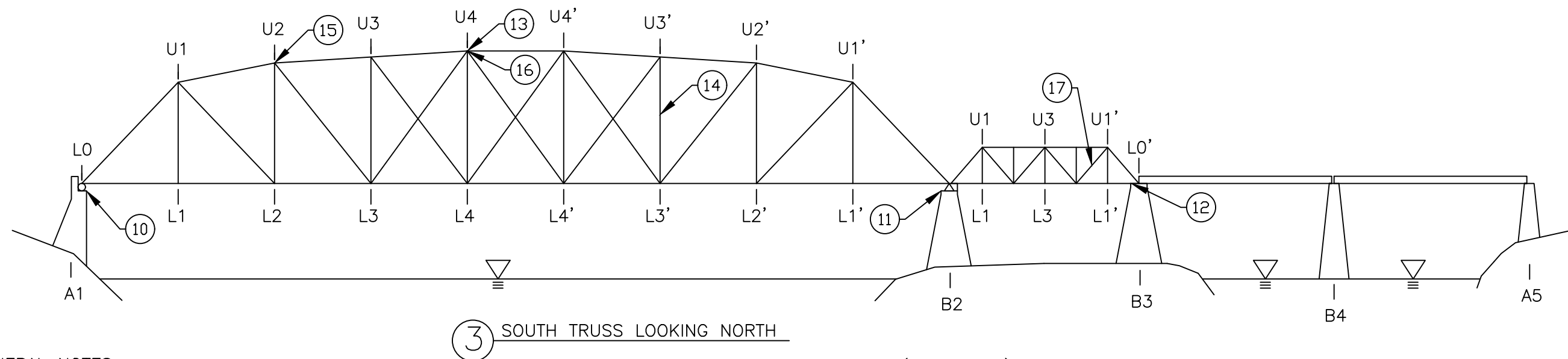
1. ROLLER BEARING AT ABUTMENT 1 HAD FAILED PAINTED COATING ON APPROXIMATELY 25 PERCENT OF THE SURFACE AREA WITH MODERATE CORROSION AND PITTING UP TO $\frac{1}{16}$ IN. TO THE STEEL UNDERNEATH, 10 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINT WAS CHALKING. HEAVY CORROSION UNDER THE ROLLERS AND ROLLER KEEPER RESULTING IN THE ROLLER KEEPER SPLITTING. THE NESTED ROLLER KEEPER HAD FAILED. TWO OF THE ROLLERS ALONG WITH A PORTION OF THE KEEPER WERE OUT FROM UNDERNEATH THE TRUSS TO THE WEST OF THE BEARING AND ONE ROLLER WAS STICKING OUT FROM UNDERNEATH THE BEARING TO THE EAST. THE ANCHOR RODS HAD UP TO 25 PERCENT SECTION LOSS AT THE CONCRETE INTERFACE DUE TO HEAVY CORROSION. THE TOP PLATE WAS DISPLACED 1.75 IN. TO THE WEST (IN EXPANSION) IN RELATION TO THE BOTTOM PLATE.

SPECIFIC NOTES (CONTINUED)

2. THE NORTH SPAN FIXED BEARINGS HAD A FAILED PAINTED COATING ON APPROXIMATELY 5 PERCENT OF THE SURFACE AREA WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 10 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS CHALKING.
3. THE SLIDING BEARINGS AT BENT 3 OF THE NORTH TRUSS WAS UNPAINTED AND HAD MODERATE CORROSION WITH PITTING UP TO $\frac{1}{16}$ IN. DEEP. THE TOP PLATE WAS DISPLACED $1-\frac{1}{2}$ IN. TO THE EAST (IN EXPANSION) IN RELATION TO THE UPPER FLANGE OF THE BEARING.
4. THE EXTERIOR FLANGE OF VERTICAL L1-U1 WAS BENT 1 IN. TO THE NORTH DUE TO IMPACT DAMAGE APPROXIMATELY 5 FT. ABOVE THE BRIDGE DECK.
5. THE INTERIOR FLANGE OF VERTICAL L2'-U2' WAS BENT 1 IN. OVER A 6 IN. HEIGHT DUE TO IMPACT DAMAGE.
6. THE INTERIOR FLANGE OF DIAGONAL L2'-U1' WAS BENT $1-\frac{3}{8}$ IN. OVER A 24 IN. LENGTH DUE TO IMPACT DAMAGE.
7. THE EXTERIOR GUSSET PLATE AT U1'N HAD TWO MISDRILLED $\frac{3}{4}$ IN. DIAMETER HOLES.
8. DIAGONAL U1'-L0' HAD (7) AREAS OF IMPACT DAMAGE UP TO $\frac{3}{4}$ IN. LONG AND $\frac{1}{4}$ IN. OF DEFLECTION SPACED OVER A 15 IN. LENGTH.
9. 2 LOOSE BOLTS AT UPPER HORIZONTAL STRUT CONNECTION U2'N.



CEI PROJECT 11696-25
INSPECTED BY: MJB
DRAWN BY: NWW
CHECKED BY: DRG
DATE: 6-14-2019
SHEET NO: A-2



GENERAL NOTES:

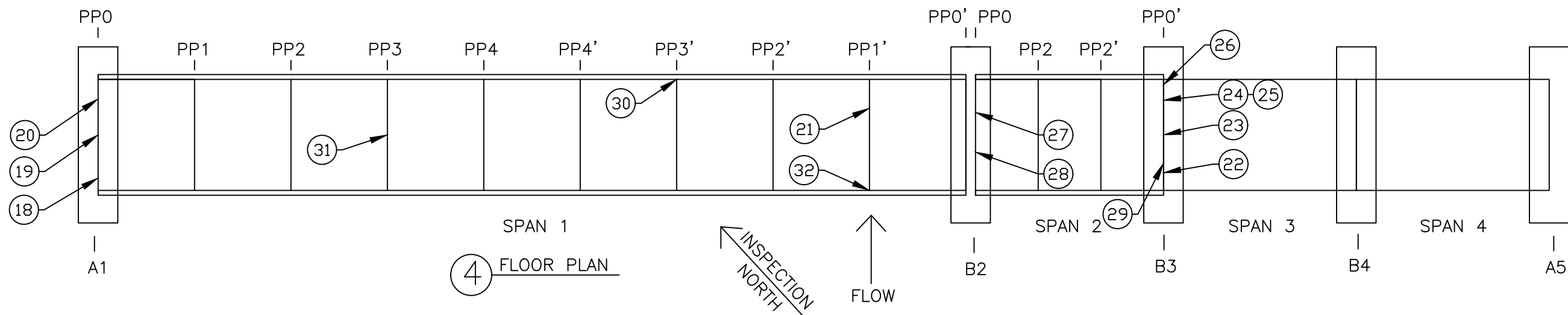
- a. APPROXIMATELY 5 PERCENT OF THE PAINTED COATING HAD FAILED ON THE VERTICALS, UPPER CHORD, AND DIAGONAL MEMBERS WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 5 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, 5 PERCENT WAS CHALKING, AND THE REMAINING PAINTED COATING WAS IN GOOD CONDITION.
- b. APPROXIMATELY 15 PERCENT OF THE PAINTED COATING HAD FAILED ON THE LOWER CHORD WITH MODERATE CORROSION WITH NEGLIGIBLE SECTION LOSS, 25 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING.
- c. APPROXIMATELY 40 PERCENT OF THE PAINTED COATING ON THE BRACING HAD FAILED WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 40 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING.

SPECIFIC NOTES:

10. ROLLER BEARING AT ABUTMENT 1 HAD FAILED PAINTED COATING ON APPROXIMATELY 25 PERCENT OF THE SURFACE AREA WITH MODERATE CORROSION AND PITTING UP TO $\frac{1}{16}$ IN. IN THE STEEL UNDERNEATH, 10 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINT WAS CHALKING. HEAVY CORROSION UNDER THE ROLLERS AND ROLLER KEEPER RESULTING IN THE ROLLER KEEPER SPLITTING. THE NESTED ROLLER KEEPER HAD FAILED. THE ROLLER KEEPER HAD BROKEN AWAY FROM THE BEARING DUE TO HEAVY CORROSION AND WAS PUSHED AGAINST THE ABUTMENT BACKWALL. ONLY HALF OF THE ROLLERS WERE STILL WITHIN THE BEARING BUT NOT FULLY IN CONTACT WITH THE BEARING PLATES. THE TOP PLATE WAS DISPLACED $1-\frac{1}{2}$ IN. TO THE WEST (IN EXPANSION) IN RELATION TO THE BOTTOM PLATE.

SPECIFIC NOTES (CONTINUED)

11. THE SOUTH SPAN FIXED BEARINGS HAD A FAILED PAINTED COATING ON APPROXIMATELY 5 PERCENT OF THE SURFACE AREA WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 10 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS CHALKING.
12. THE SLIDING BEARINGS AT BENT 3 OF THE SOUTH TRUSS WAS UNPAINTED WITH MODERATE CORROSION AND PITTING UP TO $\frac{1}{16}$ IN. DEEP. THE TOP PLATE WAS DISPLACED $1-\frac{3}{4}$ IN. TO THE EAST (IN EXPANSION) IN RELATION TO THE UPPER FLANGE OF THE BEARING.
13. ONE BOLT WAS SHEARED OFF AT UPPER HORIZONTAL STRUT TO TOP CHORD U4S CONNECTION PLATE.
14. THE LOWER HORIZONTAL SWAY BRACING AT U3' WAS BENT 2 IN. TO THE EAST, AND UPWARD AND DOWNWARD 1 IN. DUE TO IMPACT DAMAGE.
15. ONE BOLT WAS LOOSE AT UPPER HORIZONTAL STRUT TO TOP CHORD U2S CONNECTION PLATE.
16. ONE BOLT WAS LOOSE AT UPPER HORIZONTAL STRUT TO TOP CHORD U4S CONNECTION PLATE.
17. DIAGONAL L2'-U1' WAS BENT $\frac{3}{4}$ IN. OVER 12 IN. AT L2'.



GENERAL NOTES:

- a. FLOOR BEAMS EXHIBITED FAILURE OF APPROXIMATELY 40 PERCENT OF THE PAINTED COATING WITH MINOR SURFACE CORROSION AND NEGLIGIBLE SECTION LOSS, 40 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING.
- b. PAINTED STRINGERS EXHIBITED FAILURE OF APPROXIMATELY 30 PERCENT OF THE PAINTED COATING WITH MODERATE CORROSION WITH UP TO $\frac{1}{16}$ IN. THICK RUST SCALE, 15 PERCENT HAD FAILED WITH EXPOSED PRIMER UNDERNEATH, AND THE REMAINING PAINTED COATING WAS BUBBLING AND PEELING. THE 20 PERCENT OF STRINGERS THAT WERE UNPAINTED HAD MINOR TO MODERATE CORROSION WITH NEGLIGIBLE SECTION LOSS.

SPECIFIC NOTES:

- (18) STRINGER 7, ABUTMENT 1, HEAVY CORROSION AND SECTION LOSS IN THE WEB 17 IN. LONG BY 2 IN. HIGH WITH A 1 IN. HIGH BY 10 IN. LONG HOLE CENTERED 10 IN. FROM THE STRINGER END.
- (19) STRINGER 5, ABUTMENT 1, HEAVY CORROSION AND UP TO 50 PERCENT SECTION LOSS 10 IN. LONG BY 1 IN. HIGH ADJACENT TO TO STRINGER END.
- (20) STRINGER 2, ABUTMENT 1, HEAVY CORROSION AND SECTION LOSS IN THE WEB 14 IN. LONG BY 2 IN. HIGH WITH A 2.5 IN. LONG BY $\frac{3}{4}$ IN. HIGH HOLE CENTERED 2 IN. FROM THE STRINGER END.
- (21) FB8, SPAN 1, BOTTOM WEST FLANGE BENT UPWARDS $\frac{1}{2}$ IN. OVER A 6 IN. LENGTH APPROXIMATELY 16 IN. FROM THE NORTH END.
- (22) STRINGER 8, BENT 3, HEAVY CORROSION AND SECTION LOSS IN THE WEB WITH (3) HOLES RANGING IN SIZE FROM $\frac{1}{4}$ - $\frac{1}{2}$ IN. IN DIAMETER LOCATED AT WEB TO LOWER FLANGE INTERFACE AT THE STRINGER END.

SPECIFIC NOTES:

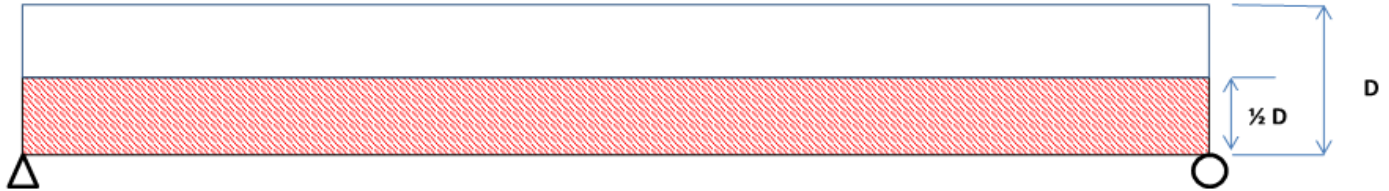
- (23) STRINGER 7, BENT 3, HEAVY CORROSION AND UP TO 50 PERCENT SECTION LOSS 10 IN. LONG BY 2 IN. HIGH ADJACENT TO THE STRINGER END AND HAD A $\frac{1}{2}$ IN. DIAMETER HOLE LOCATED 6 IN. FROM THE STRINGER END.
- (24) STRINGER 5, BENT 3, HEAVY CORROSION AND SECTION LOSS IN THE WEB WITH A 6 IN. LONG BY 1 IN. HIGH HOLE NEAR STRINGER END. BOTTOM FLANGE WAS KNIFE-EDGED IN THIS AREA.
- (25) STRINGERS 4, 5, AND 7, BENT 3, GAP BETWEEN THE BOTTOM FLANGE AND THE SUPPORTING BEARING SEAT OF THE BENT. MOVEMENT OBSERVED WHEN TRAFFIC PASSED OVER (GAP CLOSED).
- (26) STRINGER 2, BENT 3, HEAVY CORROSION AND UP TO $\frac{1}{8}$ IN. THICK RUST SCALE ON BOTH SIDES OF WEB AT WEB TO BOTTOM FLANGE INTERFACE ADJACENT TO STRINGER END.
- (27) STRINGER 2, BENT 2 (PONY TRUSS), HEAVY CORROSION AND SECTION LOSS IN WEB WITH (2) HOLES: 10 IN. LONG BY 1.5 IN. HIGH HOLE AND A 6 IN. LONG BY 1 IN. HIGH HOLE CENTERED 16 IN. FROM THE STRINGER END.
- (28) STRINGER 5, BENT 2 (PONY TRUSS), 16 IN. LONG BY 2 IN. HIGH AREA OF DELAMINATION UP TO $\frac{1}{4}$ IN. THICK ON BOTTOM OF WEB LOCATED 12 IN. FROM END OF STRINGER ON SOUTH FACE.
- (29) BENT 3, SPAN 2, THE HOLLOW STRINGER BEARING PIPE TYPICALLY MOVED UP TO $\frac{1}{4}$ IN. WHEN VEHICLES PASSED OVER. THE SOUTH ANCHOR ROD WAS BROKEN AND THIS END MOVED UP TO $\frac{1}{2}$ IN.
- (30) 2 OF 2 BOLTS LOOSE AT STRINGER 1 TO FB6 CONNECTION.
- (31) 2 OF 2 BOLTS LOOSE AT STRINGER 5 TO FB3 CONNECTION.
- (32) STRINGER 8 FROM FB2' TO FB1' WAS ROTATED APPROXIMATELY 1 IN. TO THE

Fracture Critical Floor Beam Inspection Plan and Reporting Form



Asset #: 03719 Bridge #: L32101000+01001
Feature Intersected: Bitterroot River

Inspection Date: June 14th, 2019



Consider the fracture critical portion of the floor beam as the lower half of the beam depth, the portion below the neutral axis that is in tension. Note any defects and label the defect accordingly. Make sure and note that a defect is Near Face (NF), Far Face (FF) or Both Faces (BF). All notations will be recorded looking ahead on line. Use this drawing for trusses or two girders system bridges with solid rolled or built up section floor beams.

Typical Floor Beam Comments: Approximately 40 percent of the painted coating on the floor beams had failed with minor surface corrosion and negligible section loss, 40 percent had failed with exposed primer underneath, and the remaining painted coating was bubbling and peeling.

Span	Panel Point	Inspection Comment	Photos
1	1	Typical Condition	N/A
1	2	Typical Condition	N/A
1	3	Typical Condition	N/A
1	4	Typical Condition	N/A
1	4'	Typical Condition	N/A
1	3'	Typical Condition	N/A
1	2'	Typical Condition	N/A
1	1'	The bottom west flange of FB1' had bent upwards 1/2 in. over a 6 in. length approximately 16 in. from the north end.	SMS
2	1	Typical Condition	N/A
2	2	Typical Condition	N/A
2	3	Typical Condition	N/A
2	3'	Typical Condition	N/A
2	2'	Typical Condition	N/A
2	1'	Typical Condition	N/A

APPENDIX B – Photographs

Please refer to SMS Report for all photographs.

APPENDIX C – Fracture Critical Inspection Procedures

FRACTURE CRITICAL (FC) INSPECTION PROCEDURES

1. Fracture Critical (FC) Inspection Procedure
 - I. Review the following documents in SMS and discuss any questions with MDT:
 - a) FC inspection Procedure
 - b) Previous inspection report
 - c) Most recent underwater inspection report (if applicable)
 - d) Any other Special inspections or Repair items occurring since the most recent fracture critical inspection
 - II. Team leader holds a pre-inspection meeting to review procedure with team
 - III. Notify MDT contract manager of anticipated inspection schedule
 - IV. Once team arrives onsite, team leader reviews safety risks and precautions with team before beginning inspection work
 - V. Team members perform inspection roles as directed by team leader and according to FC inspection sequence
 - VI. Once inspection of all elements is complete, onsite QC review performed
 - VII. Immediately notify MDT contact of any critical findings
2. Onsite Safety Risks and Precautions
 - I. One-lane bridge with decent amount of traffic.
3. Traffic Control Measures Needed
 - I. Traffic Control: "Bridge Inspection Crew Ahead" signs to be posted at both approaches.
4. Equipment Needed for Arm's Length Inspection of FC Members
 - I. SPRAT rope access climbing gear including ropes, anchors, ascenders, descenders
 - II. Beam clamps to slide floor beams
5. Manpower Needed for Arm's Length Inspection of FC members
 - I. SPRAT certified rope access climbers required (SPRAT II or III on-site Supervisor)
 - II. A team of 4 climbers is recommended

6. Staging Areas and Access Locations

- I. Park on the shoulder at the west approach.

7. Notification Required for Any Local Agencies

- I. None required.

8. Fracture Critical Risk Factors to Consider

- | | |
|---|---|
| <input checked="" type="checkbox"/> Fatigue and fracture prone details | <input checked="" type="checkbox"/> Load posted |
| -Forged eye bar heads | <input type="checkbox"/> <i>Missing or damaged posting signs</i> |
| <input type="checkbox"/> Problematic materials | <input type="checkbox"/> Substructure condition code of 4 or less |
| <input type="checkbox"/> Poor welding techniques | <input type="checkbox"/> Subject to overloads or impact damage |
| <input checked="" type="checkbox"/> Potential out-of-plane distortion details | <input checked="" type="checkbox"/> Older service life |
| -Distortion of verticals and sway braces | <input type="checkbox"/> Debris |
| <input type="checkbox"/> Previous cracking or repairs - retrofits | <input type="checkbox"/> High ADTT |
| <input type="checkbox"/> <i>Source of Cracking</i> | |
| <input type="checkbox"/> Cold service temperatures | |
| <input type="checkbox"/> Superstructure condition code of 4 or less | |

9. General Inspection Procedure Comments

- I. Truss panel points labeled West to East, L0 – L4 – L0' and L0 – L3 – L0'. In order to perform an arm's length inspection, the engineer climbers used a combination of rope access techniques. The engineer climbers used a two rope system in accordance with SPRAT guidelines. Anchors for the ropes were rigged off the upper chord. All of the vertical truss members were either descended or ascended using rope access equipment. An arm's length inspection of the lower chord panel points was obtained by descending below the lower chord connections to examine the underside of the truss and by walking the lower chord with fall protection. The diagonals were inspected using rope-to-rope transfers from one upper panel point to the adjacent lower panel point. The floor beams and stringers were inspected utilizing beam clamps.

10. Sketch of Bridge with Fracture Critical Members Identified in Red

- I. See sketch on the following page

11. MDT Bridge Bureau Contact Info:

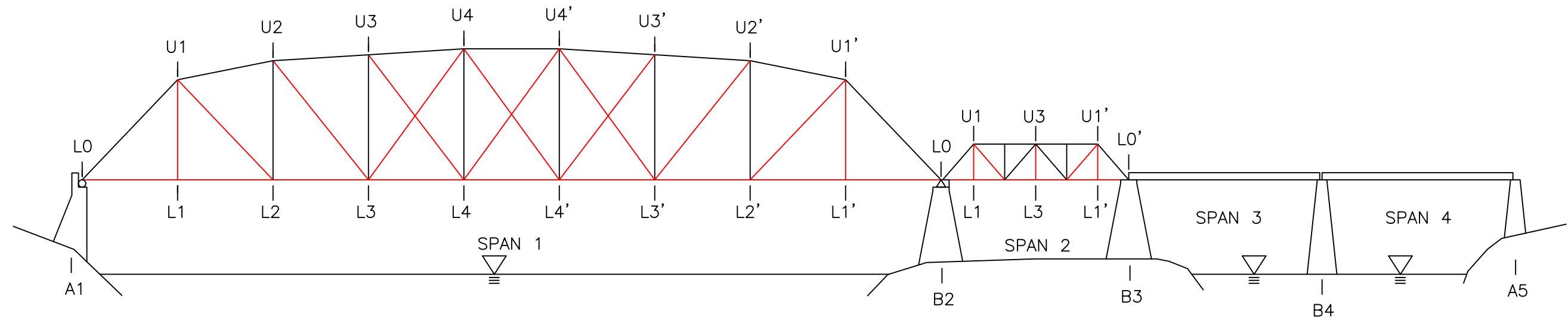
- I. Amanda Jackson, P.E. – Bridge Management Engineer – 406-444-9219
- II. Charles Horinek, P.E. – QA Engineer – 406-444-6470
- III. Andy Cullison, P.E. – QA Engineer – 406-444-6264
- IV. Mary Smith, P.E. – QA Engineer – 406-444-7641



Fracture Critical Member Diagram
 MacLay Bridge
 Asset # 03719, Bridge # L32101000+01001
 Missoula, MT

CEI PROJECT
 11696-25
 INSPECTED BY:
 MJB
 DRAWN BY:
 NWW
 CHECKED BY:
 DRG
 DATE:
 6-14-2019
 SHEET NO:
C-4

△ — FIXED BEARING
 ○ — MOVEABLE BEARING
 MEMBERS HIGHLIGHTED IN RED ARE FRACTURE CRITICAL
 ALL (10) FLOOR BEAMS ARE ALSO FRACTURE CRITICAL



① ELEVATION LOOKING NORTH

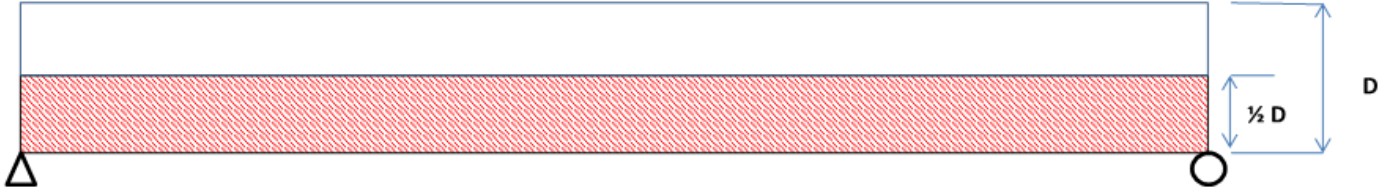
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2	1		
2	2		
2	3		
2	3'		
2	2'		
2	1'		