

BRIDGE ENGINEERING ASSISTANCE PROGRAM

BEAP Project Number: 20TTAP-11

MILLER COUNTY BRIDGE No. 2740017
on SWINGING BRIDGE ROAD over GRAND AUGLAIZE
S36, T39N, R15W

PREPARED FOR:
MILLER COUNTY COMMISSION
MILLER COUNTY, MISSOURI

OCTOBER 24, 2019

Revised: April 7, 2020

PREPARED BY:



AARON DANIEL MCVICKER
PE-2010019574

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DISCLAIMER

A full Fracture Critical Bridge Inspection was not performed by McClure Engineering Company at this site. Determination of controlling members is based on an inspection report prepared by PSBA dated September 17, 2018.

1.0 PURPOSE OF REPORT

On October 3, 2019, we visited Bridge No. 2740017 on Swinging Bridge Road over the Grand Auglaize and have reviewed the controlling members listed in a 2018 Fracture Critical Bridge Inspection (FCB) Report. The purpose of this report is to load rate the controlling members in their current state to determine if a 5-ton load posting can be restored. A secondary purpose of this report is to provide a repair recommendation to restore a 5-ton load posting, in the event the current state of the controlling members is not sufficient to restore the 5-ton load posting. This report summarizes our observations of controlling members, load posting analysis of controlling members and recommendations to restore a 5-ton load posting.

2.0 PROJECT SITE

The project site is located in Miller County, southeast of Osage Beach, Missouri and west of Brumley, Missouri on Swinging Bridge Road over Grand Auglaize at GPS coordinates of 38° 4'37.62"N, 92°31'36.42"W. S36, T39N, R15W (see Photo 1).



Photo 1 - Bridge Location

3.0 OBSERVATIONS & ANALYSIS

During our visit to the site, we observed the controlling members according to the 2018 FCB report. The bridge is suspended by 2 main suspension cables spanning between towers and anchoring to grade at each end. The east suspension cables anchor over an approach span making this bridge a 2-span suspension structure. A hanger assembly suspends from these main suspension cables, which provides floorbeam and stringer support for the timber deck.



Miller Co Bridge No. 2740017

3.1 Main Suspension Cable Members

According to the 2018 FCB report, the south main cable has several broken wires at the west anchor. During our visit, we observed approximately 52 broken wires near the southwest main suspension cable anchor. There is additional corrosion at grade.

A circumference of 14" was determined for each main suspension cable with each wire approximately 0.15" in diameter. With AutoCAD's assistance, there is estimated to be approximately 740 wires included in each suspension cable. With 52 wires broken, this accounts for a 7% loss in capacity.



Main Cable 14" Diameter



Southwest Main Cable Anchor-52 broken wires



Main Cable 0.15" Diameter Wires



Southwest Main Cable Anchor at Grade

3.2 Hanger Wire Assembly Members

The controlling hanger assemblies from the 2018 FCB report include 9 hanger assemblies, with each having multiple broken strands, additional strands with significant section loss and the remaining strands with at least 15% section loss from pitting. This deterioration equates to approximately 7 broken strands or more per hanger assembly.

There are 20 wires (10 loops) in each hanger wire assembly at each floorbeam end with each wire approximately 0.15" in diameter. The 20 wires are twisted together and secured laterally by the main suspension cable's soft wrap. The inner wire strands rub the top flange of the floorbeam resulting in severe section loss and wire failure.



Hanger rubbing on Floorbeam Flange



Hanger 0.15" Diameter Wires

3.3 Stringer Members

The stringers are not fracture critical, but are critical to traffic if undersized. Their fixity is staggered continuous and simply supported over 6ft spaced floorbeams. The 4" tall stringers are spaced at approximately 2' centers and support the timber deck.

With 2 exterior C4x5.4 stringers and 5 interior S4x7.7 stringers spanning 6', the shallow stringers are controlling member candidates.



Stringers

4.0 LOAD RATING OF CONTROLLING MEMBERS

The main suspension cable member has approximately 7% capacity reduction with 52 of the ~740 wires broken at its worst location near the southwest anchor. Although continued deterioration should be monitored, this member does not currently control the load rating.

As mentioned, the stringers are not fracture critical, but due to size, they are the next controlling member after hanger wires. A live load distribution factor using LFD design allows the internal stringer to support approximately 40% of the load while distributing the other 60% to adjacent stringers. The stringers should be monitored for continued deterioration and lack of edge distance at floorbeam top flanges connections.

The hanger wire assemblies control the load rating. Nearly all hanger assemblies have an issue to be addressed, whether it is heavy pitting, cut or worn from floorbeam top flanges, untwisted, slack or misaligned. As mentioned above, **9 hanger wire assemblies control** with an equivalent of 7 or more broken wires in a 20-wire hanger assembly. This results in a load posting below 5-ton.

From our calculations, any 20-wire hanger assembly deterioration equating to 7 broken wires or more results in a load posting below 5 tons. See Load Rating Summary in Appendix.

Therefore, **the current 3-ton load posting shall remain until repairs are performed.** See section 6.0 for repair recommendations.

5.0 PREVIOUS REPORT RECOMMENDATIONS

In 2010, a BEAP study was performed by SKW, which recommended items to be repaired to restore the bridge to a 5-ton load posting. It is assumed repairs were made as the bridge received a 5-ton load posting.

In 2016, a FCB inspection was performed by SKW and the load posting recommendation was reduced from 5 tons to 3 tons due to controlling hanger assemblies mentioned in the report. The report recommended replacing approximately 30 hanger assemblies to restore the 5-ton load posting. It is our understanding the load posting sign was changed to 3 tons after MoDOT approved the report.

In 2018, a FCB inspection was performed by PSBA and confirmed the posted limit was 3-tons according to executive summary and inspection photos.

In our recent 2019 BEAP site visit, the 3-ton load posting was confirmed and the sign matched the sign in the 2018 FCB photos.



Posted 3 Tons

6.0 REPAIR RECOMMENDATIONS

According to the 2018 FCB inspection report, span 1 hanger assemblies appear to be less deteriorated than span 2. However, several span 1 hanger assemblies are untwisted or loose.

In reviewing the combined deterioration of each hanger assembly, there are two recommendations offered to restore the 5-ton load posting, with the second being preferred. Each recommendation offers 2 material options for replacement.

The **first recommendation is to replace 9 controlling hanger assemblies** which immediately restrict the bridge from being posted at 5 tons. The immediate controlling hanger assemblies include:

North Hanger Wire Assembly: H4, H15, H43, H48, H52.

South Hanger Wire Assembly: H37, H47, H51, H67.

The **second recommendation is to replace all hanger assemblies**. Most hanger wires remain from original construction and approximately 68 additional hanger assemblies are likely to reduce the load posting back to 3 ton in a short time frame from the deterioration documented in the 2018 FCB inspection report. It may be beneficial to replace all hanger wires at one time to match original construction.

To match the original construction, the new hanger assemblies shall be 20 (10 loops) #9-gauge wires twisted taught, aligned vertically and attachment to match original method (floorbeam to main suspension cable). In addition to original hanger assembly replacement, a rub-guard or saddle may be added to the floorbeam's top flange to reduce section loss to the rubbing wires. An alternative replacement material to original wire construction is to use 1 loop of 5/8" diameter, 6x19, galvanized wire rope.

An additional recommendation is to **add another timber runner to each wheel line** along the interior of each runner. During our visit, we witnessed several vehicles with insufficient wheel spacing to remain on both timber runners. It is recommended each timber runner be widened from ~24" to ~36".



Wheel Line Width



Runner Damage due to width

It is also recommended to **remove or cut back vegetation** from around the bridge to allow moisture to escape.

The west main suspension cable anchors show signs of corrosion at grade. It is anticipated more wires may fail and may be necessary to review preventative options to reduce this corrosion or increase the concrete anchorage.



Vegetation at Anchor

7.0 REPAIR COST ESTIMATE

We have attached a breakdown of our cost estimate options for each recommendation. Each include hanger assembly replacements (9 hangers vs all hangers), full length timber runner additions, removal of vegetation and traffic control. Our cost estimates differ from our 2010 cost estimate with a contractor anticipated to make repairs rather than Local County Forces. We included estimates for #9 gauge wire (10 loops) assemblies to maintain original aesthetics and a wire rope option.

Our opinion of the estimated cost to replace 9 hanger assemblies (10 loops of #9 gauge wire), add timber runners and remove vegetation is approximately \$12,000.

Our opinion of the estimated cost to replace 9 hanger assemblies (5/8" diameter wire rope), add timber runners and remove vegetation is approximately \$10,700.

Our opinion of the estimated cost to replace all 82 hanger assemblies (10 loops of #9 gauge wire), add timber runners and remove vegetation is approximately \$80,000.

Our opinion of the estimated cost to replace all 82 hanger assemblies (5/8" diameter wire rope), add timber runners and remove vegetation is approximately \$56,000.

8.0 HANGER WIRE ASSEMBLY REPLACEMENT DETAIL

We have attached a detail of a hanger wire assembly replacement.

A detail of the wire rope option is located on page 6 of BEAP study (11HSP-02).

We appreciate the opportunity to be of service to Miller County under the Bridge Engineering Assistance Program.

If you have any questions, please call Aaron at 660-385-6441.

Sincerely,

MCCLURE ENGINEERING COMPANY



Aaron McVicker, P.E.

APPENDIX

LOAD RATING SUMMARY

Fig. 136.7.4--Load Rating Summary Sheet

Load Factor Rating Method

LPA: <u>Miller County</u>	Consultant Firm: <u>McClure Engineering Co</u>
Bridge Number: <u>2740017</u>	Engineer of Record: <u>Dustin Berry, P.E.</u>
Project Number: <u>20TTAP-11</u>	Rating Date: <u>10/11/2019</u>

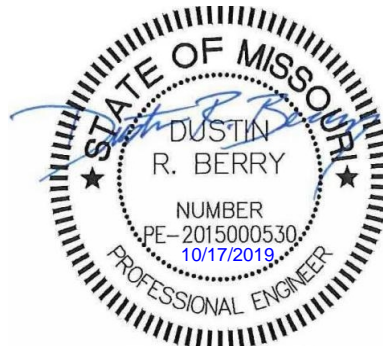
Wearing Surface Thickness: 0

Design Load Ratings

	Controlling Member	Rating Location	Controlling Load	Rating Factor	Tonnage Value
HS20-Inventory	H48	2.5	Tension	0.13	4
HS20-Operating	H48	2.5	Tension	0.21	7

Legal Load Ratings

	Controlling Member	Rating Location	Controlling Load	Rating Factor	Tonnage Value
MOH20-Posting	H48	2.5	Tension	0.18	4
MO3S2-Posting	H48	2.5	Tension	0.18	7
MO5-Operating	H48	2.5	Tension	0.09	6



DUSTIN R. BERRY
PE-2015000530

COST ESTIMATES

BREAKDOWN OF REPAIR RECOMMENDATIONS

OPTION 1, 2, 3 & 4

**ENGINEER'S OPINION OF CONSTRUCTION COST
 WORK PERFORMED BY THE CONTRACTOR**

LINE	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
REPAIR RECOMMENDATIONS - OPTION 1					
1	Removal of Hanger Wire Assembly	EA	9	\$100.00	\$900.00
2	Installation of Hanger Wire Assembly-9 gauge loops	EA	9	\$300.00	\$2,700.00
3	Installation of Timber Deck Runner	LF	1054	\$3.50	\$3,689.00
4	Removal of Vegetation	LS	1	\$1,500.00	\$1,500.00
5	Traffic Control	LS	1	\$2,200.00	\$2,200.00
6	Mobilization	LS	1	\$1,000.00	\$1,000.00
TOTAL CONTRACTOR					\$11,989.00

Bridge No. 2740017
 Miller County, MO
 Repair Recommendations - Option 2-wire rope

**ENGINEER'S OPINION OF CONSTRUCTION COST
 WORK PERFORMED BY THE CONTRACTOR**

LINE	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
REPAIR RECOMMENDATIONS - OPTION 2					
1	Removal of Hanger Wire Assembly	EA	9	\$100.00	\$900.00
2	Installation of Hanger Wire Assembly-5/8"wire rope	EA	9	\$160.00	\$1,440.00
3	Installation of Timber Deck Runner	LF	1054	\$3.50	\$3,689.00
4	Removal of Vegetation	LS	1	\$1,500.00	\$1,500.00
5	Traffic Control	LS	1	\$2,200.00	\$2,200.00
6	Mobilization	LS	1	\$1,000.00	\$1,000.00
TOTAL CONTRACTOR					\$10,729.00

**ENGINEER'S OPINION OF CONSTRUCTION COST
 WORK PERFORMED BY THE CONTRACTOR**

LINE	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
REPAIR RECOMMENDATIONS - OPTION 3					
1	Removal of Hanger Wire Assembly	EA	164	\$100.00	\$16,400.00
2	Installation of Hanger Wire Assembly-9 gauge loops	EA	164	\$300.00	\$49,200.00
3	Installation of Timber Deck Runner	LF	1054	\$3.50	\$3,689.00
4	Removal of Vegetation	LS	1	\$1,500.00	\$1,500.00
5	Traffic Control	LS	1	\$2,200.00	\$2,200.00
6	Mobilization	LS	1	\$7,000.00	\$7,000.00
TOTAL CONTRACTOR					\$79,989.00

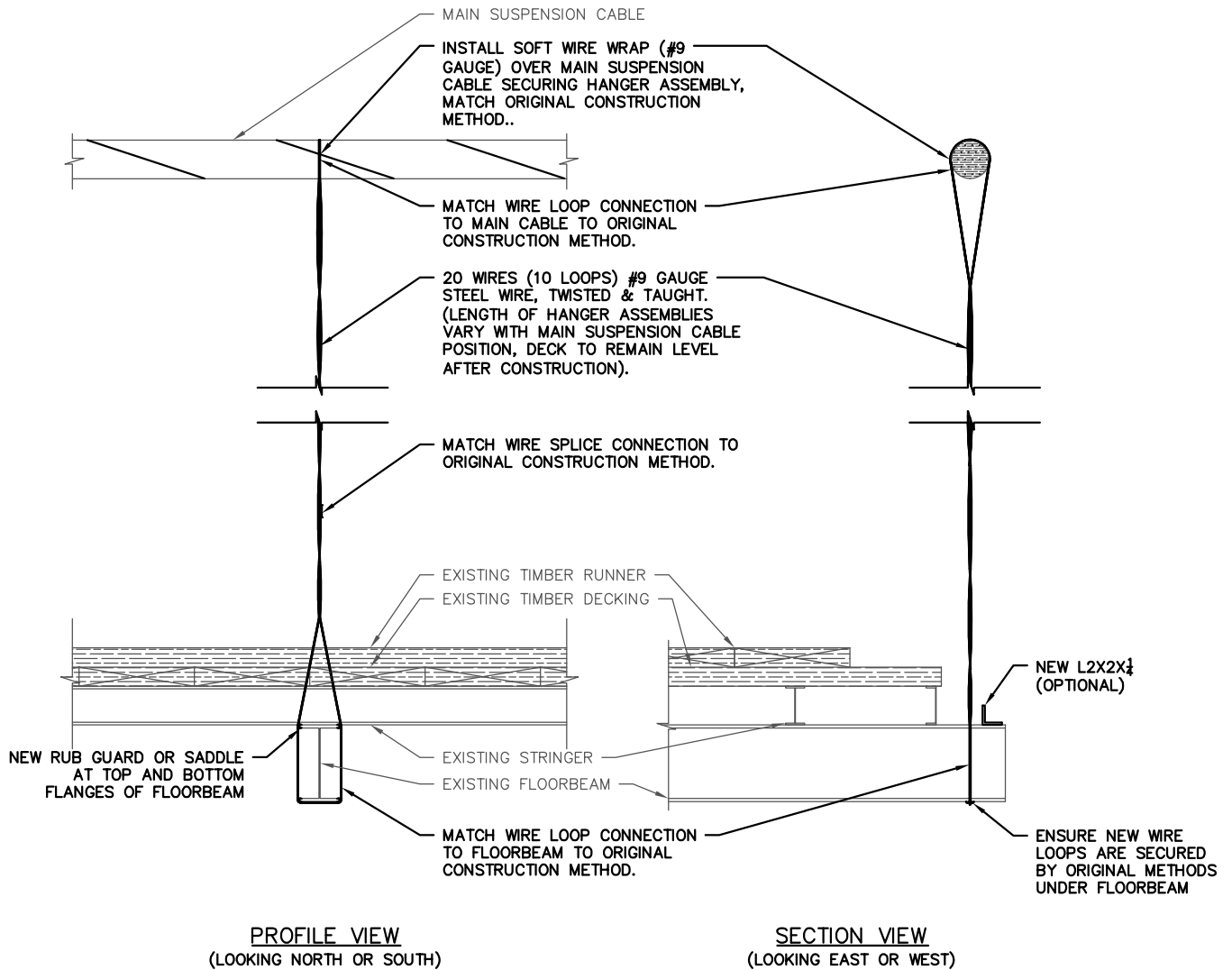
Bridge No. 2740017
 Miller County, MO
 Repair Recommendations - Option 4-wire rope

**ENGINEER'S OPINION OF CONSTRUCTION COST
 WORK PERFORMED BY THE CONTRACTOR**

LINE	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
REPAIR RECOMMENDATIONS - OPTION 4					
1	Removal of Hanger Wire Assembly	EA	164	\$100.00	\$16,400.00
2	Installation of Hanger Wire Assembly - 5/8"wire rope	EA	164	\$160.00	\$26,240.00
3	Installation of Timber Deck Runner	LF	1054	\$3.50	\$3,689.00
4	Removal of Vegetation	LS	1	\$1,500.00	\$1,500.00
5	Traffic Control	LS	1	\$2,200.00	\$2,200.00
6	Mobilization	LS	1	\$6,000.00	\$6,000.00
TOTAL CONTRACTOR					\$56,029.00

REPAIR DETAILS

HANGER WIRE ASSEMBLY REPLACEMENT



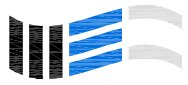
HANGER WIRE ASSEMBLY

ONE FLOORBEAM END SHOWN

NOTES:

CONSTRUCTION AND CONNECTIONS TO MATCH ORIGINAL CONSTRUCTION METHODS SUCH AS HANGER WIRE SPLICES, SOFT WIRE WRAPS, WIRE TO FLOORBEAM AND MAIN CABLE CONNECTIONS, AND TWISTING TO BE TAUGHT.

#9 GAUGE WIRE SHALL MATCH ORIGINAL AS CLOSE AS POSSIBLE TO MAINTAIN THE HISTORIC METHOD OF CONSTRUCTION. NO GALVANIZED OR STAINLESS STEEL WIRE TO BE USED UNLESS GRANTED BY THE MILLER COUNTY COMMISSION.



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ENGINEERING CO.

making lives better

PROJECT NUMBER	DATE	DRAWN BY
191227-000	2019-10-16	DRB



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