



**Engineering Support Services and Recommendations for Roadside Safety Issues or Problems
for Member States**

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MICHIGAN DOT 54-INCH FOUR-TUBE BICYCLE BRIDGE RAILING

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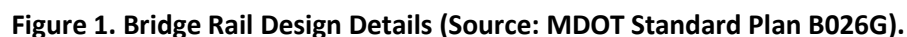
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DISCLAIMER

Opinions and conclusions provided in this report are based on review of information currently known to the author(s). If new relevant research or crash testing information becomes available, opinions or conclusions presented in this report should be re-evaluated considering the new information. Author(s) bears no responsibility to provide a revised report or opinion based on the new information. Users of this report are expected to stay informed of future research and periodically review their practices based on more current information. Opinions and conclusions provided in this report are for the specific safety hardware and/or application(s) described herein. They are not intended for other similar hardware and/or application(s).

This document provides an assessment of the Michigan Department of Transportation (MDOT) Four-Tube Bicycle Bridge Railing to determine its compliance with American Association of State Highway Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH) (1) Test Level 4 (TL-4) criteria as requested by MDOT.

The assessed MDOT Four-Tube Bicycle Bridge Railing comprises of a steel post-and-beam bridge rail mounted on a curb or sidewalk (Figure 1). The posts are W6x25 with four rails attached at heights of 16.5 inches, 28 inches, 41 inches, and 52 inches. The total height of the bride rail is 54 inches. The W6x25 posts are welded to a 1-inch-thick base plate.



An analysis methodology was developed as part of NCHRP Project 20-07 (Task 395), “MASH Equivalency of NCHRP Report 350-Approved Bridge Railings” to evaluate bridge railings according to MASH. The methodology considered three criteria for the MASH evaluation of bridge railings: stability, rail

geometrics, and strength (2). The criteria established under NCHRP Project 20-07 (Task 395) methodology were used to assess the MASH compliance of the MDOT Four-Tube Bicycle Bridge Railing.

MASH Compliance Assessment

The MDOT Four-Tube Bicycle Bridge Railing was assessed for MASH compliance following the methodology established under NCHRP Project 20-07 (Task 395). The following sections assess the system according to stability, rail geometrics, and strength criteria.

Stability Assessment

The MDOT Four-Tube Bicycle Bridge Railing has a height of 54 inches. The minimum height requirement for a MASH TL-4 bridge rail system is 36 inches. Therefore, the MDOT Four-Tube Bicycle Bridge Railing meets the MASH TL-4 stability criterion.

Rail Geometrics Assessment

Post setback distance, ratio of contact width to height, and vertical clear opening were determined for the MDOT Four-Tube Bicycle Bridge Railing. The appropriate data points were plotted against updated AASHTO LFRD Section 13 geometric relationships established under NCHRP Project 22-35 (3). As seen in Figure 2 and Figure 3, the rail geometrics plot in the acceptable regions. Therefore, the snagging potential is low and the assessment of occupant risk is satisfactory. The MDOT Four-Tube Bicycle Bridge Railing meets the MASH TL-4 rail geometrics criterion.

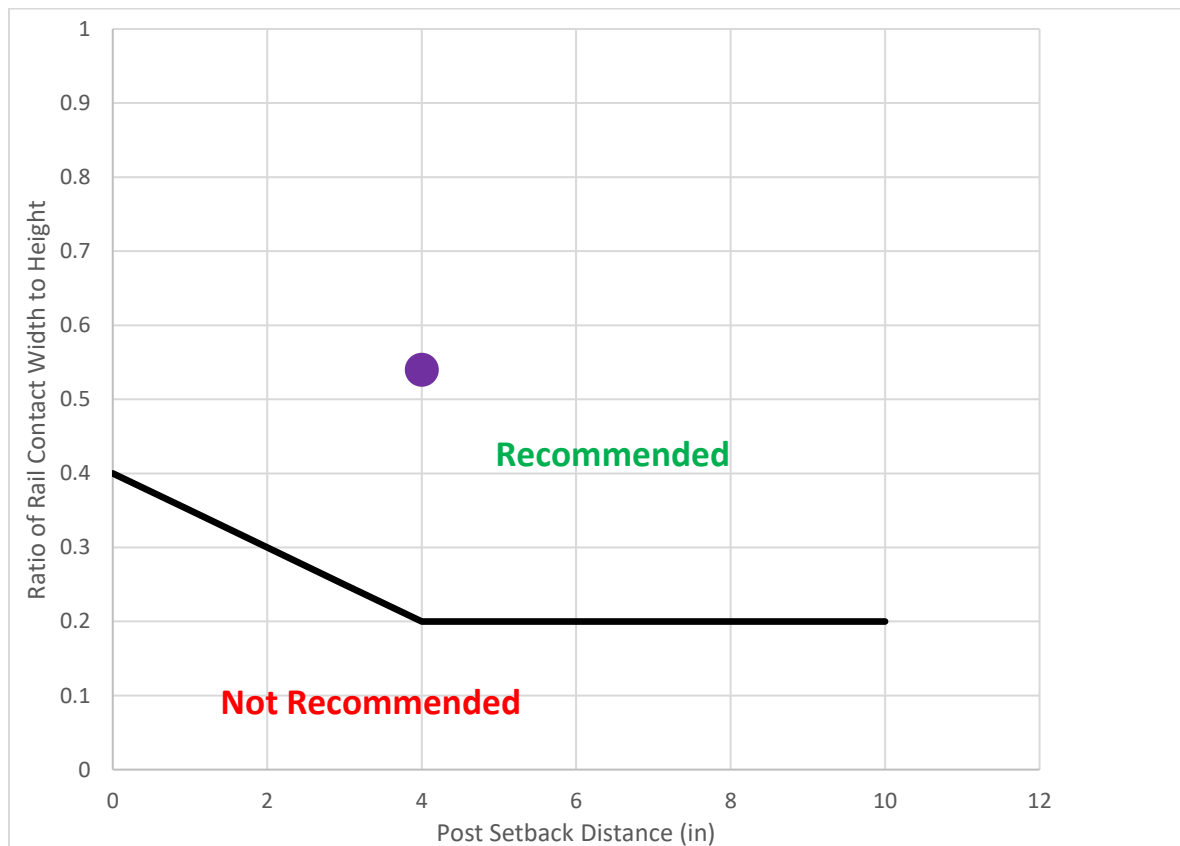


Figure 2. Post Setback Criteria.



Figure 3. Snag Potential Criteria.

Strength Assessment

The MDOT Four-Tube Bicycle Bridge Railing had a calculated resistance of 83 kips at an effective height (H_e) of 30 inches above the roadway surface. The strength was determined per AASHTO LRFD Section 13 (4). The MASH TL-4 design impact load (F_t) is 80 kips located at an effective height (H_e) of 30 inches above the roadway surface. Since the calculated resistance is greater than the design impact load, the MDOT Four-Tube Bicycle Bridge Railing meets the MASH TL-4 strength criterion.

Overall Assessment

As summarized in Table 1, the MDOT Four-Tube Bicycle Bridge Railing satisfies the three criteria of stability, rail geometrics, and strength for MASH TL-4.

Table 1. Summary of Assessment of MDOT Four-Tube Bicycle Bridge Railing.

Criteria	Required	Actual	Assessment
Stability	36 in.	54 in.	Satisfactory
Rail Geometrics	See Figure 2 and Figure 3		Satisfactory
Strength	80 kips	83 kips	Satisfactory

Conclusion

The MDOT Four-Tube Bicycle Bridge Railing was assessed for compliance according to MASH TL-4. The system was assessed according to the methodology developed under NCHRP Project 20-07 (Task 395). This included evaluating the system for height, rail geometrics, and strength criteria. The system was found to satisfy all three criteria.

The MDOT Four-Tube Bicycle Bridge Railing is considered compliant for MASH TL-4 based on the methodology developed under NCHRP Project 20-07 (Task 395).

References

- [1] American Association of State Highway and Transportation Officials, *Manual for Assessing Safety Hardware (Second Edition)*, Washington DC, 2016.
- [2] Bligh, R., Williams, W., Silvestri-Dobrovolny, C., Schulz, N., Moran, S., and Skinner, T. *MASH Equivalency of NCHRP Report 350-Approved Bridge Railings*. Report No. 607141. Texas A&M Transportation Institute, College Station, Texas, 2017.
- [3] Williams, W., Schulz, N., and Abu-Odeh, A. *Evaluation of Bridge Rail Systems to Confirm AASHTO MASH Compliance*. NCHRP Report 1024. National Academies of Science, Transportation Research Board, Washington, DC, 2022.
- [4] American Association of State Highway and Transportation Officials, *AASHTO LFRD Bridge Design Specifications (10th Edition)*, Washington DC, 2016.