Guardrail for Local Bridges

Most bridge barriers are located within the clear zone area of a roadway and thus create a fixed object that should be protected with the use of guardrail. This guide is intended to explain when and where guardrail is required on local bridge projects.

Guardrail IS required

1. According to Chapter 8820.9920 (PDF,1 MB) (State Aid Rules Book), guardrail is required to be installed at all bridges where design speed exceeds 40 mph, and either the existing ADT exceeds 400 or the bridge clear width is less than the sum of the approach roadway lane and shoulder widths. This is only applicable for on and off-system rural and suburban undivided section roadway bridges.

Guardrail NOT required

1. According to Chapter 8820.9920 (PDF, 1 MB) (State Aid Rules Book), bridges with lower design speeds (≤ 40 mph) don't require guardrail and bridges with higher design speeds (> 40 mph) and lower existing ADT (≤ 400) also don't require guardrail.
2. According to the MnDOT Road Design Manual (RDM) Chapter 10 (PDF, 1.5 MB), a guardrail is not required if:
    - The design speed is less than 40 mph
    - The bridge is located within the limits of a municipality
    - The roadway is either an urban section with curbs and sidewalk berm or a rural section in which the bridge width equals or exceeds the width of the approach roadway inclusive of the shoulders.

Note that for safety reasons it may be prudent to install guardrail on certain projects, even if the project doesn't meet the requirements for guardrail. See FAQ – Q3 for funding information in these instances.

There are some useful tools for evaluating your current guardrail system on the MnDOT website. These tools can help you decide to repair or replace your current system.

- MnDOT Technical Memorandum No. 17-07-TS-02 – W-Beam Guardrail Upgrade Considerations for Preservation Projects (PDF, 235 KB)
- MnDOT Roadside Safety Design/Guardrail Evaluation
- MnDOT Roadside Safety Design/Guardrail FAQs

Frequently Asked Questions (FAQs)

Q1: Is guardrail required on all four corners of the bridge?

MnDOT RDM Figure 10-7.01C (PDF, 20 KB) describes the requirements for guardrail locations at a bridge. Essentially if it's a bridge that carries two-way traffic and the gutter to gutter width is less than two times the clear zone width (per the appropriate rules book chart), then all four corners need guardrail with end treatments. For all other situations, refer to the MnDOT RDM Figure 10-7.01C (PDF, 20 KB).

The MnDOT RDM Chapter 10 (PDF, 1.5 MB) is a good resource for information regarding guardrail system design and requirements.

Q2: If guardrail is required, can we opt out of installing it?

This is not a recommended practice. If it meets the requirements for guardrail, then a variance would be required to remove the guardrail from the plans. Furthermore, it is advised to talk to the local agency attorney to discuss the ramifications of removing a required safety component.

Q3: If a guardrail is not required, can it still be used and covered by bridge funds?

Contact the District State Aid Engineer (DSAE) to discuss this funding issue. The DSAE will need to discuss this with the State Programs Engineer to see if bridge funds can be used.

Q4: Do we need to use the new Type 31 guardrail system?

Yes and no. For new bridges, the use of the new Type 31 guardrail system is required. There are occasions of crash repairs or bridge repairs when it is prudent to install portions of the old guardrail system. There is a new MnDOT Technical Memorandum which discusses the requirements for bridge preservation projects: Technical Memorandum No. 17-07-TS-02 (PDF, 235 KB).

The new Type 31 guardrail system was developed to meet the requirements of the new Manual for Assessing Safety Hardware (MASH) safety requirements for roadside barriers. It differs from the older W-Beam guardrail system in an increased height (old system was 27" and the new system is 31") and a stronger Thrie-Beam connection (which transitions to a W-Beam away from the bridge) at the bridge. This new connection is much taller and has more connection bolts. It can only be connected to a Single Slope (Type S) Barrier or a Vertical Face Parapet barrier.

It is advised to use the new Type 31 guardrail system if at all possible.

Q5: Can the new Type 31 guardrail be connected to an F-Barrier or an older barrier?

No. The new Type 31 connection plate is simply too tall and doesn't interface well with the sloped face of the older Type F barriers. The MnDOT Bridge Office has used a Type F to Type S barrier transition which transitions into the new Type S (Single Slope) barrier, of which there are standard connection details for. They are also developing transition details for Type G and Type J bridge barriers. Contact the State Aid Bridge Office if you'd like assistance in determining if this barrier transition is needed.

See the Technical Memorandum No. 17-07-TS-02 (PDF, 235 KB) for more details regarding existing bridges.

Q6: If there is a barrier protected sidewalk or shared-use trail on the bridge, should guardrail be used between the trail and the roadway?

These cases should be looked at on a case-by-case basis. While the use of guardrail would help protect the trail users and the motorists, it also can present safety issues for the bicyclists using the trail. There are other issues in these cases, such as roadway curbs and/or drainage issues.

Contact the State Aid Bridge Office for guidance and/or help developing plans for these situations.

Q7: Can guardrail be used when there is no approach panel?

Yes, but approach panels are recommended. Approach panels offer room to get the guardrail connection away from the bridge superstructure, which in cases of traffic impact would lessen the damage to the bridge. Also, approach panels offer better drainage in the area of the guardrail, which would lessen the undermining of any guardrail posts and weakening the system in a crucial area.

If the shoulder has bituminous pavement, then the pavement limits can go beyond the guardrail and the steel guardrail posts can be driven through the pavement. This method can alleviate erosion issues at the guardrail posts.

Q8: What happens if the bridge barrier is outside of the roadway clear zone?

If the bridge barrier is outside the clear zone (but the rules would require the use of guardrail), then per MnDOT RDM Figure 10-7.01C (PDF, 20 KB) we would require installing guardrail on the two traffic-side entry corners of the bridge.

Q9: Can guardrail be curved around a corner of a nearby roadway intersection?

There are occasions where a roadway intersection is within the limits of the designed guardrail system length. In these cases the guardrail can be curved around the corner. Depending on the design length of the system and the roadway design speed, it may be such that an end treatment may be waived in some cases [but an end anchorage would still be needed – see Std. Plan 5-297.692 (1 of 2) and Std. Plan 5-297.692 (2 of 2)]. These should be evaluated on a case-by-case basis and the DSAE and/or State Aid Bridge Office should be contacted early in the design phase of the project.

There are some curved guardrail detail sheets that are available upon request. These were sheets that were developed for standards but have not been released at this time. Contact the State Aid Bridge Office for guidance and details.

Q10: Can all guardrail systems be the minimum design length?

No, each guardrail system should be designed in accordance to the MnDOT RDM Chapter 10 (PDF, 1.5 MB) guidance. With that being said, the 'Length of Need' for many local bridges may fall within the minimum design

lengths required for the complete system (transition at the bridge + W-Beam guardrail segment + end treatment).

In many cases the obstacles being protected are the bridge barrier and a water feature, so the LH (Lateral Offset to the furthermost point of the hazardous object) distance may simply be the clear zone distance for the associated roadway section.

The State Aid Bridge Office has an internal 'Length of Need' spreadsheet that we can share upon request, but simply using a graphical method may be the easiest way to come up with the design length needed (per the MnDOT RDM – Chapter 10).

Q11: What can be done for installing guardrail on a low-fill concrete box culvert bridge?

There are two options for the installation of guardrail on low-fill concrete box culvert projects. Since the fill height doesn't allow for a full length of guardrail post to be installed, there is a Standard Plan Sheet (Std. Plan 5-297.696) that will span up to 25' without guardrail posts. This will essentially clear span the culvert.

The other option (but is not a standard detail) is a connection plate that is welded to the steel guardrail post and then is bolted through the roof of the box culvert. Contact the State Aid Bridge Office for details and CADD files if you want to proceed with this option. Please note that using this option will require some extra review time while we contact our Bridge Office Standards Unit for acceptance.

Q12: Should we use wood posts or steel posts for our guardrail system?

The new Type 31 guardrail system uses steel posts. The use of wood posts is pretty much confined to the repair of an older wood post guardrail system. Steel guardrail posts are now the norm.

Q13: What Standard Plan sheets should we use in our bridge plans?

The guardrail sheets to be used in a bridge plan could vary depending on the bridge details. If there is a barrier-separated trail on the bridge, then there might be a need for some custom modifications to some of the standard sheets.

For a 'normal' rural section local bridge (over water), use the following sheets:

1. Std. Plan 5-297.601 (2 of 3) – General layout of the guardrail system.
2. Std. Plan 5-297.601 (3 of 3) – Ditch slopes and end treatment configurations.
3. Std. Plan 5-297.690 (1 of 2) – Type 31 assembly details.
4. Std. Plan 5-297.690 (2 of 2) – Type 31 component details.
5. Std. Plan 5-297.692 (1 of 2) – Type 31 end anchorage (trailing end) details.
6. Std. Plan 5-297.692 (2 of 2) – Type 31 end anchorage component details.
7. Std. Plan 5-297.694 (1 of 5) – Type 31 bridge transition details.
8. Std. Plan 5-297.694 (2 of 5) – Type 31 bridge transition component details.
9. Std. Plan 5-297.694 (3 of 5) – Type 31 bridge transition Thrie-Beam details.
10. Std. Plan 5-297.694 (4 of 5) – Type 31 bridge transition curb details (Type S Barrier).
11. Std. Plan 5-297.694 (5 of 5) – Type 31 bridge connection details (Type S Barrier).
12. Std. Plan 5-297.695 (1 of 1) – Type 31 Thrie-Beam to W-Beam transition details.

Please note that the 5-297.692 (1 of 2) and 5-297.692 (2 of 2) sheets would likely be omitted if the bridge has end treatments on all 4 corners. These sheets are used when a guardrail system ends (trailing end) without an end treatment.

Currently there are two (2) approved end treatments for the new Type 31 guardrail system. Please see the MnDOT Approved Products List for details on these end treatments. It is a good practice to show some general details of the end treatment in the bridge plan and the bridge specifications will denote approved end treatments that can be used. It is not a good practice to show just one manufacturers end treatment sheets in a bridge plan. The contractor should be given a choice of any of the approved end treatment systems.