

Tech Brief

November 2021

Maintenance of Damaged Guardrail Systems

CATEGORY: Maintenance

ISSUE: Oftentimes it may not be immediately obvious when a w-beam guardrail or terminal is damaged to the extent that it may no longer function as intended. If the consequences of damaged hardware are not properly assessed, repairs may not be made in a timely manner, leading to poor crash performance and opening the responsible authority to possible legal action.

OBJECTIVE: To recommend general guidelines that enable agency personnel to determine when repairs to damaged (or deteriorated) guardrail and terminals should be a high priority.

METHODOLOGY: Several typical "damage" scenarios for w-beam guardrails and terminals will be identified and best-practices will be presented for consideration. NCHRP Report 656, Criteria for Restoration of Longitudinal Barriers, is the primary reference; it should be noted that information included in the report is based on NCHRP 350 testing of the 27 ¾" guardrail system.

To function properly in an impact, guardrail must be able to reach its full tensile strength and prevent override/ underide. Guardrail terminals must be able to anchor the guardrail in side impacts and minimize crash severities in end-on impacts. The following sections identify damage likely to significantly compromise the crash performance of these safety appurtenances, and thus should be considered a high priority.

GENERAL: For all significant barrier system damage, appropriate delineation should be provided as soon as practical. If a spearing condition is present and cannot be immediately repaired, the spear end should be lowered to the ground and retained by rebar pin(s).

When the installation is damaged beyond repair, the opportunity to upgrade the system to the latest standard should be taken. If a significant length of sub-standard height guardrail is damaged and the whole system is not being upgraded, the repaired length should be done to the latest standard for that system.



Illinois Department
of Transportation



U.S. Department of Transportation
Federal Highway Administration



EXPECTED RESULTS:

Provide repair personnel with information that will allow them to evaluate barrier and terminal damage and to schedule appropriate repair, removal, upgrades, or redesign.

W-Beam Rail damage:

Perhaps the most catastrophic failure of a guardrail is vehicle penetration allowed by physical separation (rupture) of the rail element or over-riding the guardrail. Therefore, any damage that significantly decreases the tensile strength of the w-beam rail or reduces its height to less than 26" should be considered a high-priority repair.

- Vertical tears in the W-beam (Photo A) that extend to the top or bottom of the rail greatly reduce the capacity of the rail and create areas of high stress concentrations, both of which can cause the rail to tear completely through and allow vehicular penetration upon impact.
- Non-manufactured holes (e.g., those caused by crash damage, lug nut damage, or corrosion) in the rail element that intersect the top or bottom edges of the W-beam
- Rail flattening may increase the chances that an impacting vehicle will overturn upon contact as well as increase the deflection distance. Any flattened panel that increases the W-beam section width to more than 18 inches (normal height is 12 inches) should be replaced.
- Damage at the splice where more than 1 bolt is missing or damaged, or the rail is torn can also compromise the continuity of the system. (Photo B).

Post / deflection damage:

If the barrier has been deflected more than 9 inches over a 25-foot length, (Photo C), or if any posts are missing or ineffective due to tears, rot, broken or detached, prompt repairs should be made (the 31" can function with one missing post if no curb is present). These types of damage can result in greater vehicle instability in a crash, possibly leading to rollover, barrier rupture, or barrier override.

Terminal damage:

Historically (and three current MASH design), W-beam guardrail terminals were designed to transmit tensile forces in the rail to a cable and ground anchor system. This anchor keeps the rail in tension for side impacts near the end of the barrier installation.

- If the end post is broken or if either the cable is not attached or the steel bearing plate is missing (Photo D), the anchorage is lost and any motorist striking the rail just downstream from the treatment end would likely penetrate the system rather than be redirected.
- For those terminal designs that incorporate a compression-based, energy-absorbing head, the head should be properly aligned and in position with the W-beam rail element so the rail is fully embedded and will "feed" into it in any head-on crash (Photo E), absorbing the vehicle's energy. Missing lag screws at the impact head can result in misalignment of the head. It is critical that the axial strength of the rail be maintained (i.e., on a straight line with no kinks or bends).

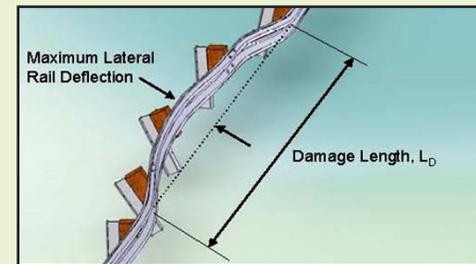
Blunt ends and turned down terminals are not considered to be crashworthy and FHWA has recommended that they be removed from the National Highway System (NHS). If either of these terminals are damaged, there is an opportunity to replace them with a current crashworthy terminal. In addition, FHWA has recommended that the Breakaway Cable Terminal (BCT) and the Modified Eccentric Loader Terminal (MELT) (except for TL-2) be replaced when located within a project on the NHS. If any of these terminals are damaged beyond repair, this also is an opportunity to upgrade to a current crashworthy terminal and create a safer roadside. Also, if a device is impacted numerous times, the proper staff should be informed so a cause and potential solution can be explored.



A



B



C



D



E