Roadway Departure Technical Brief No. 1

Guardrail Installations at Intersections, Side Roads, and Driveways

CATEGORY: Design

ISSUE: When shielding bridge parapets or large culverts, nearby roads, streets, or driveways that must remain open to traffic frequently prevent the installation of the full design length of need (LON). In such cases, it is critical that the primary hazard be effectively shielded while adjusting the design to address secondary concerns to the extent practical.

OBJECTIVE: Establish general guidelines that enable designers to develop plans and specifications that provide the most effective barrier installation practical at these restricted locations.

METHODOLOGY: Present several common problem situations and identify best practice design solutions for consideration. In each case, the desired performance characteristics of the installation will be emphasized and a specific solution presented. The FHWA letters referenced in this document can be seen at http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/. Additional information and detailed drawings for many of these features are also on AASHTO's Task Force 13 website at www.aashtotf13.org.

GENERAL: Effectively shielding the identified hazard is the primary consideration in any barrier installation. For the most common barrier installations, these hazards may include bridge ends, a portion of the road, stream, or river that the bridge (or culvert) spans, steep embankments, trees, non-breakaway signs, street lights, or traffic signal supports. Challenges arise when the full barrier length of need (LON) cannot be installed due to an intervening access point that cannot be closed or relocated. In that case, a curved barrier installation is often used. To work well, a curved guardrail installation must:

- Develop tension along its side parallel to the main roadway to minimize deflection upon impact,
- Stiffen gradually over a fixed distance whenever the downstream end of a semi-rigid guardrail is connected to a bridge rail end (parapet) or other rigid object,
- Use weakened posts in the curved section to reduce the chances of a vehicle vaulting over the w-beam, and
- Minimize high-angle, high-speed impacts into the curved section by installing a separate barrier run upstream from the access point.

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TDOT

EXPECTED RESULTS:

Designers have enough background information to allow them to develop curved barrier installations that effectively shield all potential hazards to the maximum extent practicable.

With these design considerations in mind, the following practical approaches address common situations where a curved guardrail installation is often used.

- *Bridge/culvert located adjacent to intersecting side road or driveway:* Providing an adequate transition between the approach guardrail and the rigid bridge railing or culvert headwall is the primary design concern. Generally, the minimum required length of barrier would be 50 feet of guardrail terminal (assuming the use of an energy-absorbing guardrail terminal) plus the length of the transition design. If a curved guardrail is used the main run of barrier leading to the bridge must be long enough so the portion parallel to the main road will remain under tension when struck. The barrier in **photograph A** has an adequate transition to the bridge railing, but a high-speed impact into the curved rail could result in a penetration. TDOT's Standard Drawing S-PL-2 should be used wherever the area beyond the rail is hazardous.

  A crash cushion can be used to shield the bridge end if the available distance from the structure to the intersecting roadway parallel to the main roadway is too short, as is the case in **photograph B**. TDOT's curved rail design may be used if space is available.

  If the area upstream from the intersecting roadway requires shielding, a separate barrier installation upstream from the access point reduces the chances of intrusion into the curved rail. Since the curved portion may be subjected to high angle impacts, TDOT's design uses yielding posts in the radius. This modification to standard rail minimizes the potential for a vehicle to push over the posts, drag the rail down, and vault over the barrier. However, if the area behind the radius is traversable as in **photograph C**, TDOT's curved rail for local roads may be appropriate. A similar design was crash tested successfully at approximately 45 mph (Test Level 2) and is appropriate for use on lower speed roads. An NCHRP Project has been proposed to develop a TL-3 design.

- *Fixed object hazards (e.g., traffic signal/overhead sign supports) located within curve radius area:* Most barrier installations used to shield traffic signals and other non-breakaway supports at intersections are largely ineffective for high-speed, high angle impacts because they will deflect significantly and allow impact into the "shielded" object. Additional posts, shown in **photograph D**, do not add enough strength to prevent impact into the shielded traffic signal support at high speeds. Whenever practical, locating these fixed objects farther from the roadway is the preferred treatment. Some commercial crash cushions have been developed and tested for these point hazards.

A

B

C

D