800 ROADSIDE DESIGN

HIGHWAY DESIGN

Chapter

ROADSIDE DESIGN

Subject

Design Elements

HD-801.1 GENERAL

AASHTO's *Roadside Design Guide* and engineering judgment should be used for roadside safety design.

The roadside is the area between the outside edge of the usable shoulder and the right-of-way limits. The area between roadways of a divided highway may also be considered the roadside. The roadside is as vital to the safe operation of a vehicle as the pavement itself.

Roadside safety design is an essential component of the total highway design and should be thoroughly considered during the design process. The goal of roadside safety design is to create an unencumbered roadside recovery area which allows for errant vehicles to recover and supports a roadside design where serious consequences are reduced.

When feasible, the designer should follow the suggested roadside safety options listed below:

- Remove the obstacle.
- Redesign the obstacle so that it can be safely traversed.
- Relocate the obstacle to a point where it is less likely to be struck.
- Reduce impact severity by using an appropriate breakaway device.
- Shield the obstacle with a traffic barrier or a crash cushion.
- Delineate the obstacle if the above alternatives are not appropriate.

HD-801.2 CLEAR ZONE

An important concept in roadside design is the clear zone. Clear zone is the total roadside area available for safe use by errant vehicles, starting at the edge of the traveled way. The traveled way is the portion of the roadway for movement of vehicles, exclusive of the shoulders and bicycle lanes.

Clear-zone width is not a geometric design element subject to the Design Exception Process; however, a discussion of clear zone is required in the Design Executive Summary (DES).

Clear-zone width is dependent upon traffic volumes, design speed, and roadside geometry. The designer should consider the context of the existing and adjacent roadways, as well as associated crash data when selecting a clear-zone width. The clear zone should be consistent within the project corridor. (See AASHTO's *Roadside Design Guide* for specific information.) For clear zones on low volume and low speed roads, see the FHWA Publication No. FHWA-CFL/TD-05-009, *Barrier Guide for Low Volume and Low Speed Roads*.

The clear-zone area may consist of a shoulder, a recoverable slope, a nonrecoverable slope, and/or a clear runout area. Foreslopes parallel to the flow of traffic may be identified as recoverable, nonrecoverable, or critical.

- A *recoverable slope* is a slope on which a motorist may retain or regain control of the vehicle. Slopes 4:1 and flatter are generally considered recoverable.
- A *nonrecoverable slope* is a slope that is considered traversable, but on which the errant vehicle will continue to the bottom. Slopes between 3:1 and 4:1 may be considered traversable, but nonrecoverable.
- A *critical slope* is a slope on which the vehicle is likely to overturn. Slopes steeper than 3:1 are generally considered critical.

Note: If an area is not likely to be maintained free of fixed objects, it should not be considered part of the clear-zone area.

In addition to side slopes, there are slopes created by median crossovers, berms, driveways, or intersecting side roads. The *Roadside Design Guide* refers to these slopes as "transverse slopes." These are generally more critical to errant motorists than foreslopes or backslopes because they are typically struck head-on. Transverse slopes of 6:1 or flatter are suggested for high-speed roadways.

Another important consideration when evaluating clear zone is configuration of the roadside ditches in cut situations. The designer should refer to AASHTO's *Roadside Design Guide* for specific information concerning suggested foreslope and backslope combinations of proposed ditches.

HD-801.3 ROADSIDE BARRIERS

The primary goal of the road designer is to provide an adequate clear zone free of any rigid obstacles. When it is not practical to provide a full clear zone, traffic

barriers should be considered.

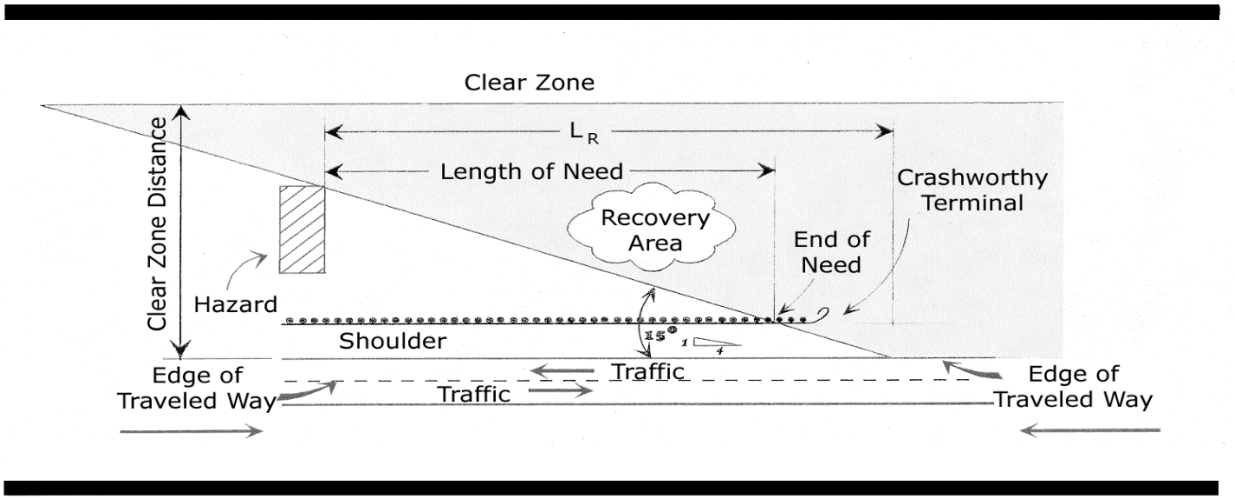
Note: Barriers are hazards in and of themselves and should only be used when the barrier is less of a hazard than the object itself. Barriers should comply with the National Cooperative Highway Research Program (NCHRP) *Report 350* or AASHTO's *Manual for Assessing Safety Hardware* (MASH) guidelines.

A roadside barrier is a longitudinal barrier used to shield motorists from either natural or manmade obstacles located along either side of the traveled way. There are occasions when barriers may be used for reasons other than shielding motorists from obstacles (for example, road closure barricades and barriers protecting pedestrians or sensitive areas).

Through judicious arrangements and a balance of geometric features, every highway should be designed to preclude or minimize the need for barriers or other protective devices. When it is determined that a barrier is to be utilized, the designer should refer to the Transportation Cabinet's ***Standard Drawings*** and to AASHTO's *Roadside Design Guide* for specific information concerning lateral offsets, barrier deflection, terrain effects, flare rates, and length of need.

When determining the placement of a roadside barrier, the designer should note that the Transportation Cabinet utilizes a fixed vehicle encroachment (divergence) angle of 15 degrees from the edge of the traveled way to the obstacle. This calculation derives the "Length of Need" for the barrier.

Note: "Length of Need" begins with the first non-breakaway portions of the barrier. The following figure is an illustration of "Length of Need":



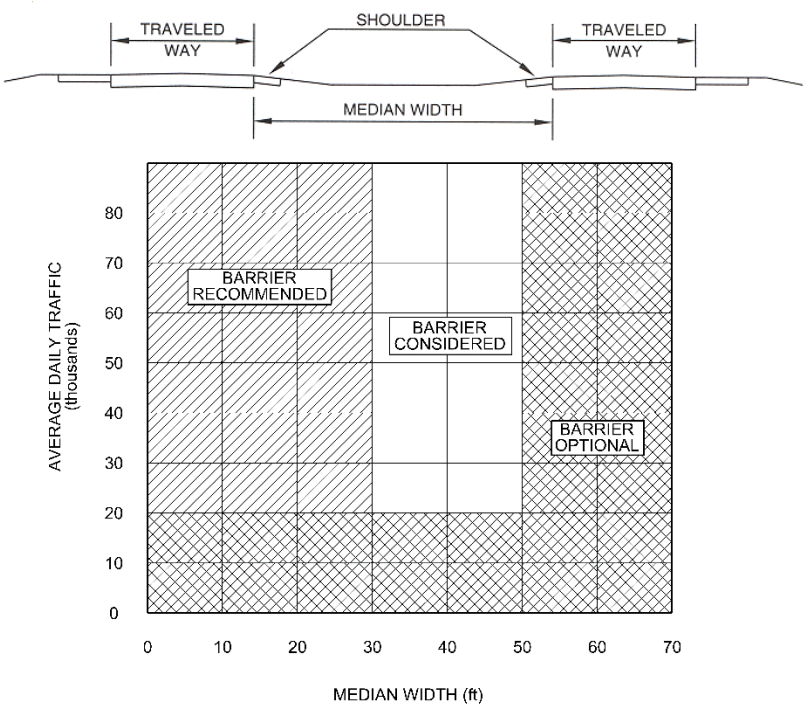
Length of Need

HD-801.4 CURBS

Except for impacts at very low operating speeds, curbs typically have no redirectional qualities. When a curb is adjacent to the traveled way, the minimum operational clearance shall be 2 feet. For roadways with design speed ranging between 30 and 45 mph and with a curb adjacent to the traveled way, the border should be free of obstacles. The use of guardrail within the border area should be carefully evaluated. If guardrail is utilized in the border area, it should present less of a hazard than the obstacle being shielded. For clear zones in urban areas, see Chapter 10 of AASHTO's *Roadside Design Guide* for further guidance.

HD-801.5 MEDIAN BARRIERS

A median barrier is a longitudinal barrier used to separate traffic on a divided highway and prevent an errant vehicle from crossing the highway median. Although similar to roadside barrier designs, most median barriers are designed to redirect vehicles striking either side of the barrier. As with all other types of traffic barriers, a median barrier should be installed only if the consequences of striking the barrier are expected to be less severe than if no barrier existed. Median barriers should comply with NCHRP Report 350 or MASH guidelines. AASHTO's *Roadside Design Guide* has guidelines for median barrier application. The following figure shows suggested guidelines for median barriers on high-speed roadways:



*Based on a 5-year projection

Suggested Guidelines for Median Barriers on High-Speed Roadways

When it is determined that a median barrier is to be utilized, the designer can refer to the Transportation Cabinet's ***Standard Drawings*** and to AASHTO's *Roadside Design Guide* for placement guidelines. KYTC's *Standard Drawings* also provides median barrier selection guidelines.

HD-801.6 END TREATMENTS & CRASH CUSHIONS

End treatments and crash cushions are frequently used to minimize the severity of impacts with fixed objects by gradually decelerating an impacting vehicle to a stop or redirecting it around the object of concern. Barrier end treatments and crash cushions should comply with NCHRP Report 350 or MASH guidelines.

An end treatment or terminal is normally used at the end of a roadside barrier where traffic passes on only one side of the barrier and in one direction only. A crashworthy end treatment is considered essential if a barrier terminates within the clear zone or is located in an area where it is likely to be struck by an errant motorist. A "crashworthy" feature is one that has been proven acceptable for use under specified conditions through crash-testing and in-service performance.

When selecting a leading-end barrier end treatment, the designer should consider the following guideline hierarchy:

- Barrier anchored in backslope—When properly designed and located, this type of anchor provides full shielding for the identified hazard, eliminates the possibility of an end-on impact with the barrier terminal, and minimizes the likelihood of the vehicle passing behind the rail.

- Flared terminals—A flared breakaway guardrail end treatment with adequate clear zone behind the gating device is used to provide recovery.

- Straight-line terminals—A straight-line delineated breakaway end treatment with adequate clear zone behind the gating device is used to provide recovery.

The grading between the traveled way and the terminal and the approach in front of the terminal should be essentially flat (typically this is the shoulder slope extended). The grading behind any gating end treatment should be properly addressed to allow errant vehicle recovery.

When considering various end treatments for the trailing end of guardrail, the designer should also consider the potential of vehicles traveling in the opposite direction and impacting the guardrail. KYTC's *Standard Drawings* provides details

on typical guardrail installations and general applications for end treatments.

Guardrail End Treatment Type 7 shall not be used on the high-speed National Highway System (NHS) routes. Guardrail End Treatment Type 7 can be considered on low-speed/low-volume facilities when an adequate recovery zone is unavailable or where conditions preclude the desired performance of other end treatment types. Appropriate justification should be retained in the project file whenever Guardrail End Treatment Type 7s are included on a project.

A crash cushion is normally used to shield the end of a barrier or a fixed object. Its function is to gradually decelerate a vehicle to a safe stop or to redirect a vehicle away from the object.

When providing a crash cushion to be installed on paved surfaces, Crash Cushion Type VI is preferred. This device requires a concrete pad and a bolt-down system, as detailed in KYTC's ***Standard Drawings***.

Crash Cushion Type IX or IXA is preferred on earth surfaces. This device requires posts and soil tubes, as detailed in *Standard Drawings*.

At-median piers (depressed medians) use a Crash Cushion Type IX attached to a concrete backup with a concrete wall between the piers.

AASHTO's *Roadside Design Guide* provides specific information concerning barrier end treatments and crash cushions. *Standard Drawings* gives specific details and applications of commonly used barrier end treatments and crash cushions.

HD-801.7 ALTERNATIVE BARRIERS

In Kentucky, standard guardrail is Strong Post W-Beam. Standard barrier wall is New Jersey-shape, which may also be used for roadside protection. Other approved systems may be used where appropriate and justified. AASHTO's *Roadside Design Guide* provides specific information for alternative barriers.