

SECTION 8

GUIDELINES FOR GUIDE RAIL DESIGN AND MEDIAN BARRIERS

8-01 INTRODUCTION

These guidelines are based on the *Roadside Design Guide, AASHTO, 2002*.

The information in this section is intended to serve as guidelines that will assist the designer in determining conditions that warrant the installation of guide rail and the dimensional characteristics of the installations. Also, this section contains information to serve as guidelines to assist the designer in determining conditions that warrant the installation of a median barrier.

It is important that application of these guidelines be made in conjunction with engineering judgment and thorough evaluation of site conditions to arrive at a proper solution.

It should be emphasized that guide rail should not be installed indiscriminately. Every effort should be made to eliminate the obstruction for which the guide rail is being considered.

In some cases, another type of traffic barrier may be more effective than guide rail. For example, obstructions in gores can often be more effectively shielded with a crash cushion. The designer should consider such alternatives and choose the most suitable solution based on safety requirements, economic limitations, maintenance, and aesthetic considerations.

8-02 GUIDE RAIL WARRANTS

8-02.1 General

Guide rail is considered a longitudinal barrier whose primary functions are to prevent penetration and to safely redirect an errant vehicle away from a roadside or median obstruction.

8-02.2 How Warrants are Determined

An obstruction's physical characteristics and its location within the clear zone are the basic factors to be considered in determining if guide rail is warranted.

Although some wide ranges of roadside conditions are covered below, special cases will arise for which there is no clear choice about whether or not guide rail is warranted. Such cases must be evaluated on an individual basis, and, in the final analysis must

usually be solved by engineering judgment. In the absence of pertinent criteria, a cost-effective analysis could be used to evaluate guide rail needs.

8-02.3 Clear Zone

Clear zone is defined as the area, starting at the edge of the traveled way, that is available for safe use by errant vehicles.

The width of the clear zone (L_c) varies with the speed, roadside slope and horizontal roadway alignment. The design speed should be used when determining the clear zone. Use "Table 2-1 Design Speed vs. Posted Speed" to determine the design speed.

Figure 8-A contains the suggested range of clear zone distances on tangent sections of roadway based on selected traffic volumes, speed and roadside slopes. Clear zones may be limited to 30 ft. for practicality and to provide a consistent roadway section if previous experience with similar projects or designs indicates satisfactory performance. According to the *Roadside Design Guide, AASHTO, 2002*, the designer may provide clear zone distances greater than 30 ft. as indicated in Figure 8-A, where such occurrences are indicated by accident history.

Figure 8-B contains examples of determining clear zone distances. More examples and further explanation are contained in the *Roadside Design Guide, AASHTO, 2002*.

Horizontal alignment does affect the clear zone width. Therefore, clear zone widths on the outside of horizontal curves should be adjusted as shown in Figure 8-C.

8-02.4 Warrants

A warranting obstruction is defined as a non-traversable roadside or a fixed object located within the clear zone and whose physical characteristics are such that injuries resulting from an impact with the obstruction would probably be more severe than injuries resulting from an impact with guide rail.

1. Non-traversable Roadside

Examples of a non-traversable roadside that may warrant guide rail are: rough rock cuts, large boulders, streams or permanent bodies of water more than 2 ft. in depth, roadside channels with slopes steeper than 1H:1V and depths greater than 2 ft., embankment slopes and slopes in cut sections as described in the following.

a. Embankment (Fill) Slopes

A critical slope is one in which a vehicle is likely to overturn. Slopes steeper than 3H:1V generally fall into this category. If a slope steeper than 3H:1V begins closer to the traveled way than the suggested clear zone distance, guide rail might be warranted if it is not practical to flatten the slope. Guide rail warrants for critical slopes are shown in Table 8-1.

**Table 8-1
Critical Slope Warrants**

Critical Embankment (fill) Slopes	Maximum Height Without Guide Rail
1 ½ H:1V	3 ft.
2H:1V	6 ft.
2 ½ H:1V	9 ft.

A non-recoverable slope is defined as one that is traversable but the vehicle can be expected to travel to the bottom of the slope before steering recovery can be obtained. Embankments between 3H:1V and 4H:1V generally fall into this category. Fixed objects should not be constructed or located along such slopes that begin closer to the traveled way than the suggested clear zone distance. A clear runout area at the base of these slopes is desirable; see Figure 8-B for an example. The designer should, therefore, evaluate each site before providing 3H:1V slopes without guide rail.

When flattening existing slopes to remove guide rail, the proposed side slopes should be recoverable, that is, 4H:1V or flatter. Where embankment slopes are being constructed, the designer should investigate the feasibility of providing a recoverable slope instead of a critical slope with guide rail. Rounding should be provided at slope breaks; see Figures 5-C, 5-H and 5-I.

b. Slopes in Cut Sections

Slopes in cut sections should not ordinarily be shielded with guide rail. However, there may be obstructions on the slope that warrant shielding, such as bridge piers, retaining walls, trees, rocks, etc. that may cause excessive vehicle snagging rather than permit relatively smooth redirection.

Slopes in cut section of 2H:1V or flatter may be considered traversable; and, as the cut slope steepens, the chance of rollover increases. Where feasible, slopes steeper than 2H:1V should be flattened. If there is a warranting obstruction on the cut slope, the following apply:

- (1) Guide rail should be installed if the warranting obstruction is on a slope flatter than 0.7H:1V and is within the clear zone width specified in Section 8-02.3 for a 3H:1V slope.
- (2) Guide rail should be installed if the warranting obstruction is on a slope of 0.7H:1V or steeper and is less than 6 ft. (measured along the slope) from the toe of the slope and is within the clear zone width specified in Section 8-02.3 for a 3H:1V slope.
- (3) Guide rail is not required if the warranting obstruction is on a slope of 0.7H:1V or steeper and is 6 ft. or more (measured along the slope) from the toe of the slope.

c. Drainage Features

Channels should be designed to be traversable. Where feasible, existing channels should be reconstructed to be traversable.

Figures 8-R and 8-S show criteria for preferred cross sections for channels. According to the *Roadside Design Guide, AASHTO, 2002*:

“...Cross sections which fall in the shaded region of each of the figures are considered to have traversable cross sections. Channel sections which fall outside the shaded region are considered less desirable and their use should be limited where high-angle encroachments can be expected, such as the outside of relatively sharp curves. Channel sections outside the shaded region may be acceptable for projects having one or more of the following characteristics: restrictive right-of-way; rugged terrain; resurfacing, restoration, or rehabilitation (RRR) construction projects; or on low-volume or low-speed roads and streets, particularly if the channel bottom and backslopes are free of any fixed objects.

If practical, roadside channels with cross sections outside the shaded regions and located in vulnerable areas may be reshaped and converted to a closed system (culvert or pipe), or in some cases, shielded by a traffic barrier. . .”

In areas where snow removal is a problem or the mailbox is placed behind guide rail, a cantilever mailbox-type support as shown in the *Standard Roadway Construction Details* may be permitted to allow snow plows to sweep under or near mailboxes without damage to their supports.

The post-to-box attachment details should be of sufficient strength to prevent the box from separating from the post top if the installation is struck by a vehicle. The *Standard Roadway Construction Details* show acceptable attachment details.

The minimum spacing between the centers of support posts shall be 75 percent of the height of the posts above the ground line.

For more information on mail stop design and mailbox location, see the *Roadside Design Guide, AASHTO, 2002*.

3. Pedestrians

Guide rail may be used where there is a reasonable possibility of an errant vehicle encroaching into an unprotected area used by pedestrians. Some examples are where a playground, school yard, or a public beach is adjacent to the right-of-way line. The basis for assessing the needs should be the accident experience of the immediate area and the specifics for the cause(s) of the accidents. There may be times when no causative factor can be isolated, and sound engineering judgment must be applied.

This policy is not intended to indiscriminately permit the installation of guide rail at every location where a request for guide rail has been received, but to offer some flexibility to the designer when unique circumstances occur.

There are locations where existing guide rail and the PVI (top of the slope) of a steep slope are both located directly behind a pedestrian sidewalk area. If new guide rail is installed in front of the sidewalk area, the existing guide rail should either be left in place or the existing guide rail should be removed and a fence installed in its place. When guide rail is placed between the roadway and the sidewalk, a rail element may be attached to the back of the guide rail post so that pedestrians are shielded from the exposed back of post. The rail element, if added, shall not be located within the 37.5 ft. parabolic flare of a slotted guide rail terminal or within the 50 ft. of an extruder terminal.

8-03 DIMENSIONAL CHARACTERISTICS

8-03.1 Clearance From the Traveled Way

1. Without Curb or Raised Berm in Front of Guide Rail

A highly desirable characteristic of any roadway is a uniform clearance from the traveled way to the guide rail. It is desirable to place the guide rail at a distance beyond which it will not be perceived as a threat by the driver, see Figure 8-E, Table-1: Shy Line Offset. In general, the following offsets and slopes should be used:

- a. To the extent possible, guide rail should be located as far as possible away from the traveled way to provide a recovery area for errant vehicles and to provide adequate sight distance along horizontal curves and at intersections.
- b. On interstate highways and freeways, the front face of the guide rail should desirably be 4 ft. or more from the outside edge of shoulder. Where this offset is not possible, the guide rail should be installed flush with the gutter line.
- c. On land service highways where there is a sidewalk or a sidewalk area used by pedestrians, the front face of the guide rail should desirably be 7 ft. or more from the outside edge of shoulder. Where this offset is not possible, the guide rail should be installed flush with the gutter line.

On land service highways where there is no sidewalk and the border area is not used by pedestrians, the front face of the guide rail may be placed any distance from the gutter line; however, an offset of 4 ft. or more is preferred.

Where providing an offset of 7 ft. or more, the designer is advised that additional right-of-way or slope easements may be necessary to construct the parabolic flare offset and/or provide the 6 ft. flat area (10H:1V minimum slope) adjacent to a slotted guide rail terminal as shown in Figure 8-D. If the purchase of additional right-of-way is infeasible, an extruder terminal should be provided at an offset of 7 ft. or more, instead of a slotted guide rail terminal. If this is still infeasible, then the guide rail should be installed flush with the gutter line to permit the construction of a slotted guide rail terminal with the parabolic flare offset and flat area.

- d. Where guide rail is located at the top of an embankment slope, the posts should be a minimum of 2 ft. from the PVI to the center of the post. When less than 2 ft. is provided, the following post lengths, shown in Table 8-2 below, should be used: