Chapter 6 (Comparison of SCOH Ballot to Final Draft, 4/12/06)

Median Barriers

6.0 OVERVIEW

Median barriers are longitudinal barriers that are most commonly used to separate opposing traffic on a divided highway. They may also be used along heavily traveled roadways to separate through traffic from local traffic or to separate high occupancy vehicle (HOV) lanes from general purpose lanes. Most median barriers are similar to roadside barrier designs described in Chapter 5. However, median barriers, as discussed in this chapter, are those designed to redirect vehicles striking either side of the barrier.

This chapter references the performance requirements for median barriers and contains guidelines for selecting and installing an appropriate barrier system. The structural and safety characteristics of selected median barriers, including end treatments and transition sections, are presented. Finally, selection and placement guidelines are included for new construction, and methods are presented for identifying and upgrading existing systems that do not comply with current guidelines.

6.1 PERFORMANCE REQUIREMENTS

The performance requirements for median barriers are identical to those for roadside barriers as stated in Section 5.1. NCHRP Report 350 (10) contains detailed information on the required series of standard crash tests needed to evaluate the performance of longitudinal barriers.

6.2 GUIDELINES FOR MEDIAN BARRIER APPLICATION

Guidelines for the use of median barrier have evolved over the past 40 years. The primary guidance that has been used was based on a limited number of studies that examined vehicle encroachment paths on flat sideslopes. The basic premise in this guidance was that 80 percent of errant motorists were able to recover within 10 m [30 ft] of the traveled way. As a result, median barriers were not typically used in areas with medians that are more than 10 m [30 ft] wide. However, in the 1990s, several states noticed an increase in the number of cross median crashes and developed new guidelines for their highways that expanded the use of median barrier. Some states adopted policies for installing median barrier based on median widths ranging from 10m [30 ft] to 23 m [75 ft]. A nationwide survey of cross median crashes in several states was conducted by FHWA in 2004, and based on responses received from over 25 states, it was found that there are a significant percentage of fatal cross median crashes occurring where median widths exceed 10 m [30 ft]. While the survey found that some cross median crashes occurred in medians in excess of 60 m [200 ft] wide, approximately two thirds of the crashes occurred where the median was less than 15 m [50 ft] in width.
It is recognized that the increased use of median barriers has some disadvantages. The initial costs of installing a barrier can be significant. In addition, the installation of a barrier will generally increase the number of reported crashes as it reduces the recovery area available. As a result, there could be increased maintenance costs to repair the barrier as well as increased exposure to the maintenance crews completing the repairs. Another concern associated with the installation of a median barrier is that it will limit the options of maintenance and emergency service vehicles to cross the median. In snowy climates, a median barrier may also affect the ability to store snow in the median. There may be other environmental impacts depending on the grading required to install the barrier. For these reasons, a one-size-fits-all recommendation for the use of median barrier is not appropriate.

Studies (6, 9) have shown that median barriers can significantly reduce the occurrence of cross median crashes and the overall severity of median-related crashes. With the potential to reduce high-severity crashes, it is recommended that median barrier be considered for high-speed, fully controlled-access roadways that have traversable medians as shown on Figure 6.1.

**Figure 6.1 Guidelines for median barriers on high-speed, fully controlled-access roadways**

Figure 6.1 recommends median barrier on high-speed, fully controlled-access roadways for locations where the median is 10 m [30 ft] in width or less and the average daily traffic (ADT) is greater than 20,000 vehicles per day. For locations with median widths less than 15 m [50 ft] and where the ADT is less than 20,000 vehicles per day, a median barrier is optional. However, the facility should be designed to facilitate future barrier placement if there are significant increases in average daily traffic and/or a history of cross-median crashes are experienced. For locations where median widths are greater than 10 m [30 ft] but less than 15 m [50 ft], and where the ADT is greater than 20,000 vehicles per day, a cost/benefit analysis or an engineering study evaluating such factors as traffic volumes, vehicle classifications, median cross over history, crash incidents, vertical and
horizontal alignment relationships and median/terrain configurations may be conducted at the discretion of the transportation agency to determine the appropriate application for median barrier installations. For locations with median widths equal to or greater than 15 m [50 ft], a barrier is not normally considered, except in special circumstances such as a location with a significant history of cross-median crashes.

Each transportation agency has the flexibility to develop their particular median barrier guidelines. For example, California completed a detailed study in 1997 that suggested medians as wide as 23 m [75 ft] with traffic volumes in excess of 60,000 vehicles per day would be candidates for a median barrier study (3). California uses a crash study warrant to identify sections of freeways that may require the installation of a median barrier. This warrant requires a minimum of 0.31 cross-median crashes per kilometer [0.50 cross-median crashes per mile] of any severity per year, or 0.075 fatal crashes per kilometer [0.12 fatal crashes per mile] per year. The rate calculation requires a minimum of three crashes occurring within a five-year period.

In some cases, it may be determined that a median barrier is only necessary at locations where there are concentrations of cross-median crashes. For example, the Florida Department of Transportation found that 62 percent of all cross-median crashes occurred within one-half mile and 82 percent occurred within one mile of interchange ramp termini (1).

Median barriers are sometimes used on high-volume facilities, which do not have fully controlled access. As indicated on Figure 6.1 these median barrier guidelines were developed for use on high-speed, fully controlled-access roadways. Utilizing these guidelines on roadways that do not have full access control requires the need for engineering analyses and judgment, taking into consideration such items as, right-of-way constraints, property access needs, number of intersections and driveway openings, adjacent commercial development, sight distance at intersections, barrier end termination, etc. Therefore, trying to apply these guidelines to roadways that do not have full access control can be rather complex in many locations.

Special consideration should be given to barrier needs for medians separating roadways at different elevations. The ability of an errant driver leaving the higher roadway to return to the road or to stop diminishes as the difference in elevation increases. Thus, the potential for crossover crashes increases. For such sections, the clear-zone criteria given in Chapter 3 should be used as a guideline for establishing barrier need. Section 6.6.1 addresses the placement of barrier on sloped medians.

6.3 PERFORMANCE LEVEL SELECTION PROCEDURES

As with roadside barriers, most median barriers have been developed, tested, and installed with the intention of containing and redirecting passenger vehicles and pickup trucks. Some highway agencies have identified locations where heavy vehicle containment was considered necessary and have designed and installed high-performance median barriers having significantly greater capabilities than commonly used designs. Factors most often considered in reaching a decision on such barrier use include

- high percentage or large average daily number of heavy vehicles,
Although any median barrier is likely to perform best when it is installed on relatively flat terrain, cable barriers have been shown to perform effectively when placed on a 1V:6H sideslope when the vehicle travels down the slope prior to impact. However, based on recent crash reports, some vehicle types, when striking a cable barrier from behind after traveling across a ditch, can underride the barrier. Computer simulation and limited full-scale testing on 1V:6H slopes has shown that the barrier will redirect vehicles after traversing the ditch when it is placed within 0.3 m [1 ft] (either side) of the ditchline. However, when the current configuration of cable median barrier was placed 1.2 m [4 ft] from the ditchline, a test with a passenger sedan showed that after crossing the ditch the vehicle reached the cables with its suspension compressed, the bumper passed under the lowest cable, and the vehicle continued through the cable median barrier with no redirection. Computer simulation has predicted that when the barrier is placed 8’ from the ditch bottom, the vehicle will be contained. Based on this testing and more recent simulation studies, it appears that maximum redirection can be achieved with the current configuration if the area from 0.3 m [1 ft] to 2.4 m [8 ft] from the ditchline on 1V:6H slopes is avoided. Additional research is needed to determine appropriate barrier offset distances for other slopes and to determine what practical modifications to the barrier can be developed to enhance its performance in locations that may be less than optimal. These placement guidelines apply to all cable barriers, including high-tension designs and 4-cable systems.

Since most reported penetrations have involved passenger vehicles with relatively low front profiles impacting at high speeds and high angles, it is not considered cost-effective to reposition existing cable barrier that has been installed within this area unless a recurring crash problem is evident.

Section II—If the embankment slope is steeper than approximately 1V:10H (Illustration 4), a median barrier should be placed at “b.” If the slope contains obstacles or consists of a rough rock cut (as discussed in Chapter 3) a roadside barrier should be placed at both “b” and “d” (Illustration 5). It is not unusual for this section to have a retaining wall at “d.” If so, it is suggested that the base of the wall be contoured to the exterior shape of a concrete median barrier. If the cross slope is flatter than approximately 1V:10H, a barrier could be placed at or near the center of the median (Illustration 6).

Section III—Placement criteria for median barriers on this cross section (Illustration 7) are not clearly defined. Research has shown that such a cross section, if high enough and wide enough, can redirect vehicles impacting at relatively shallow angles. However, this type of median design should not generally be construed to be a barrier or to provide positive protection against crossover crashes.

If slopes are not traversable (rough rock cut, etc.), a roadside barrier should be placed at “b” and “d.” If retaining walls are used at “b” and “d,” it is recommended that the base of the wall be contoured to the exterior shape of a standard concrete barrier.