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La Autoridad ha adoptado el documento adjunto como su política pública en cuanto a la selección del tipo de barreras y sus terminales. Los diseñadores desarrollarán sus diseños conforme a dichas instrucciones.

Se definen carreteras de alto volumen vehicular como aquellas que tengan un ADT presente mayor de 5,000 vehículos diarios o un ADT futuro mayor de 7,000 vehículos diarios. Se definen carreteras de alta velocidad como aquellas con velocidad operacional (posted speed) de 45 millas por hora o más.

Los planos modelos y especificaciones de la Autoridad han sido modificados en conformidad con esta política pública. El diseñador indicará en los planos el tipo de barrera a utilizarse al igual que el tipo de terminal en cada extremidad de la barrera. Todos los terminales son obligación subsidiaria de la barrera.

Será responsabilidad del diseñador el minimizar el uso de barreras según los principios expuestos en el AASHTO Roadside Design Guide.

Esta directriz entra en vigor inmediatamente.

José E. Hernández Borges
Director
Area de Diseño

10 NOV 98
Fecha

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GUIDELINES FOR THE SELECTION OF BARRIERS AND BARRIER TERMINALS

I. Introduction - These guidelines provide the basic guidance to designers, including design consultants, as to the Puerto Rico Highway and Transportation Authority policy for the selection of barrier types and barrier terminals. The purpose of these guidelines is to maximize the safety of the road user within the right of way, maintenance and other constraints faced by the Authority and existing limitations in the highway system.

Any barrier carries a certain degree of hazard upon impact, so the Authority's policy is to minimize their use, other than median barriers which are to be used when prescribed by figure 6.1 of the AASHTO Roadside Design Guide as reproduced in Attachment A.

Designers should use a barrier as a last resource and should have previously tried to eliminate the hazard by relocation, making the hazard breakaway or flattening of slopes. Refer to Attachment B for the use of flatter slopes which make the use of barriers unnecessary. Impact attenuators should be considered a preferred alternate for point hazards in lieu of barriers.

Two types of barriers have been selected, namely the strong post W beam metal barrier and the F shape concrete barrier provides the advantage of low maintenance costs and limited damage to the impacting vehicle, so they would be the first choice when a low angle of impact can be assured. Concrete barriers may be used immediately adjacent to a right or left paved shoulder. Concrete barriers should only be used on paved medians.

Four tables (I to IV) are provided, two for W beam metal barriers and two for concrete F shape concrete barriers. For each type, a new construction and a reconstruction table is provided. The reconstruction tables allow lower standards in recognition of possible site constraints. In any event, the designers should use the highest possible attainable standard in the reconstruction table within site constraints.

Attachment C describes the principal barrier layout variables. The designer should consult the AASHTO Roadside Design Guide for further details on applications.

Use of curbs and curb and gutters in conjunction with barriers is discouraged and should be avoided since the presence of the curb will modify the behavior of the vehicle impacting the barrier.

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The construction and design details of all barrier types shall conform with the Authority's standard drawings.

Exception to the guidelines, tables and standard drawings must be submitted by the designer to the Executive Director for his approval prior to their incorporation into the plans.

II. Barrier Terminal Definitions - Barrier terminals have been designated by a series of letters, those for metal barriers start with the letter M and those for concrete barriers start with the letter C. Other types of terminals such as impact attenuators, earth berms, etc. which may be used for either type carry no identifying letter. Terminals for median barriers end with the letters MED.

Metal barrier flares and offsets should conform with the following table:

Speed (mph)	Offset	Flare Rate
35 or less	2.0	7:1
40	5.5	8:1
45	7.0	10:1
50	8.5	11:1
55	9.0	12:1
60	9.0	14:1
65	9.0	14:1
70	9.0	15:1

Use the design speed for new construction and posted speed for reconstruction projects. Offsets are measured from the edge of lane, ramp or marginal road edge of pavement. In the tables, the superscript 1 indicates use on Autopistas and routes maintained by the Autopistas Area only.

Metal Barriers

Barrier Terminals Types MA and MA-MED, the metal barrier should be offset and flared as per the above table and the barrier terminal buried and anchored into the cut slope. These barriers terminals shall be used on approach ends and on leaving ends when the leaving end may be impacted from the opposite direction of travel.

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Barrier Terminals Types MB and MB-MED, the metal barrier should be offset and flared as per the above table. The blunt end will be anchored with a cable anchor as indicated in the standard drawings. These barriers terminals shall be used on approach ends and on leaving ends when the end may be impacted from the opposite direction of travel.

Barrier Terminals Types MC, these terminals are intended for leaving ends with a minimum offset of 1.0 to 2.0 meters, and used only were there is no or little probability of being impacted from the opposite direction. They shall have a blunt end similar to types MB and MB-MED.

Concrete Barriers

Barrier Terminals CD and CD-MED, shall consist of a long tapering or flare down of the concrete barrier as defined in the standard plans. This terminal shall be used on low speed approach terminals.

Barrier Terminals CE and CE-MED, shall consist of a short tapering or flare of the concrete barrier as defined in the standard drawings. They shall be used on leaving terminals when there is no or little probability of being impacted form the opposite direction.

Metal and Concrete Barriers

Barrier Terminal Impact Attenuator, shall consist of the installation of a sand filled impact attenuators to protect the barrier terminal as defined in the standard plans for impact attenuators for the appropriate speed. May be used for metal and concrete barriers.

Barrier Terminal Proprietary shall consist of any of the proprietary terminals adopted by the agency and defined in the standard drawings. May be used for metal and concrete barriers.

Barrier Terminal Earth Berm, shall consist of an earth berm to protect the barrier terminal as defined in the standard drawings. May be used for metal and concrete barriers.

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III. Tables

Table I, New Construction Metal Barrier Table - When ever possible, the Types MA and MA-MED terminals, barrier end buried in the cut face, is preferred to the Type MB and MB-MED terminals.

Whenever possible the earth berm should be selected prior to the impact Attenuator.

Table II, Reconstruction Metal Barrier Table - Apply the same guidelines and principles as for Table I.

Table III, New Construction Concrete Barrier Table- In addition to the terminals indicated in the concrete table, concrete barrier terminals may be connected to a metal barrier, which in turn will have the appropriate terminal for the type of facility and speed.

Table IV, Reconstruction Concrete Barrier Table - Apply the same guidelines and principles as for Table III.

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TABLE I
APPLICABILITY OF END TREATMENTS TO NEW CONSTRUCTION PROJECTS METAL BARRIERS

CATEGORY	DESIGN CLASSES	SINGLE FACE		MEDIAN DOUBLE FACE BARRIER	
		APPROACH TERMINALS	LEAVING TERMINALS	3.2 m < median width < 4.0 m	Median width > 4.0 m
High Volume & High Speed	RE-1, RE-2, RE-3 UE-1, UE-2, UE-3 UE-4, UE-5, R-5	Type MA Type MB	Type MC (see note)	Impact Attenuator[1]	Type MA-MED Type MB-MED Earth Berm Impact Attenuator[1]
High Volume & Low Speed	U-6, U-7, U-8	Type MA Type MB	Type MC	Metal barrier shall not be used.	Metal barrier shall not be used.
Low Volume & High Speed	RE-4, R-6	Type MA Type MB	Type MC (see note)	Impact Attenuator[1]	Type MA-MED Type MB-MED Earth Berm Impact Attenuator[1]
Low Volume & Low Speed	R-7, R-8, R-9, R-10, R-11, U-9,U-10	Type MA Type MB Type MC	Type MC	Metal barrier shall not be used.	Metal barrier shall not be used.

Note: For two way facilities with high speed both barrier terminals shall be treated as approach terminals.

[1] To be used on Autopistas only

TABLE II
APPLICABILITY OF END TREATMENTS TO HIGHWAY RECONSTRUCTION PROJECTS METAL BARRIERS

CATEGORY	SINGLE FACE		MEDIAN DOUBLE FACE BARRIER	
	APPROACH TERMINALS	LEAVING TERMINALS	Median width < 3.20 m	Median width > 3.20 m
High Volume & High Speed Urban Expressway	Type MA Type MB	Type MC (see note)	Impact Attenuator[1]	Impact Attenuator[1] Type MA-MED Type MB-MED Earth Berm
High Volume & Low Speed Urban Arterial	Type MA Type MB	Type MC	Metal barrier shall not be used. Remove existing median barrier.	Metal barrier shall not be used. Remove existing median barrier.
Low Volume & High Speed Urban Arterial	Type MA Type MB	Type MC (see note)	Impact Attenuator[1]	Impact Attenuator[1] Type MA-MED Type MB-MED Earth Berm
Low Volume & Low Speed Rural Collector	Type MA Type MB	Type MC	Metal barrier shall not be used. Remove existing median barrier.	Metal barrier shall not be used. Remove existing median barrier.

Note: For two way facilities with high speed both barrier terminals shall be treated as approach terminals.

[1] To be used on Autopistas only

TABLE III
APPLICABILITY OF END TREATMENTS TO NEW CONSTRUCTION PROJECTS
CONCRETE BARRIERS

CATEGORY	DESIGN CLASSES	SINGLE FACE		MEDIAN DOUBLE FACE BARRIER	
		APPROACH TERMINALS	LEAVING TERMINALS	3.2 m < median width < 4.0 m	Median width > 4.0 m
High Volume & High Speed	RE-1, RE-2, RE-3 UE-1, UE-2, UE-3 UE-4, UE-5, R-5	Impact Attenuator[1]	Type CE	Impact Attenuator[1]	Concrete Barrier shall not be used.
High Volume & Low Speed	U-6, U-7, U-8	Impact Attenuator[1] Type CD	Type CE	Impact Attenuator[1] Type CD-MED	Concrete Barrier shall not be used.
Low Volume & High Speed	RE-4, R-6	Impact Attenuator[1]	Type CE	Impact Attenuator[1]	Concrete Barrier shall not be used.
Low Volume & Low Speed	R-7, R-8, R-9, R-10, R-11, U-9,U-10	Type CD	Type CE	Type CD-MED	Concrete Barrier shall not be used.

Note: For two way facilities with high speed both barrier terminals shall be treated as approach terminals.

[1] To be used on Autopistas only

TABLE IV
APPLICABILITY OF END TREATMENTS TO
HIGHWAY RECONSTRUCTION PROJECTS
CONCRETE BARRIERS

CATEGORY	DESIGN CLASSES	SINGLE FACE		MEDIAN DOUBLE FACE BARRIER	
		APPROACH TERMINALS	LEAVING TERMINALS	3.2 m < median width < 4.0 m	Median width > 4.0 m
High Volume & High Speed	RE-1, RE-2, RE-3 UE-1, UE-2, UE-3 UE-4, UE-5, R-5	Impact Attenuator[1]	Type CE	Impact Attenuator[1]	Concrete Barrier shall not be used.
High Volume & Low Speed	U-6, U-7, U-8	Impact Attenuator[1] Type CD	Type CE	Impact Attenuator[1] Type CD-MED	Concrete Barrier shall not be used.
Low Volume & High Speed	RE-4, R-6	Impact Attenuator[1]	Type CE	Impact Attenuator[1]	Concrete Barrier shall not be used.
Low Volume & Low Speed	R-7, R-8, R-9, R-10, R-11, U-9,U-10	Type CD	Type CE	Type CD-MED	Concrete Barrier shall not be used.

Note: For two way facilities with high speed both barrier terminals shall be treated as approach terminals.

[1] To be used on Autopistas only

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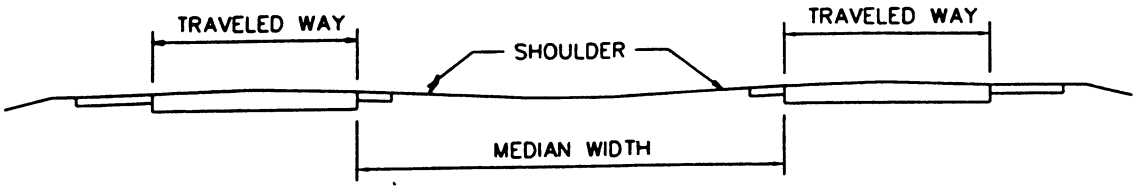
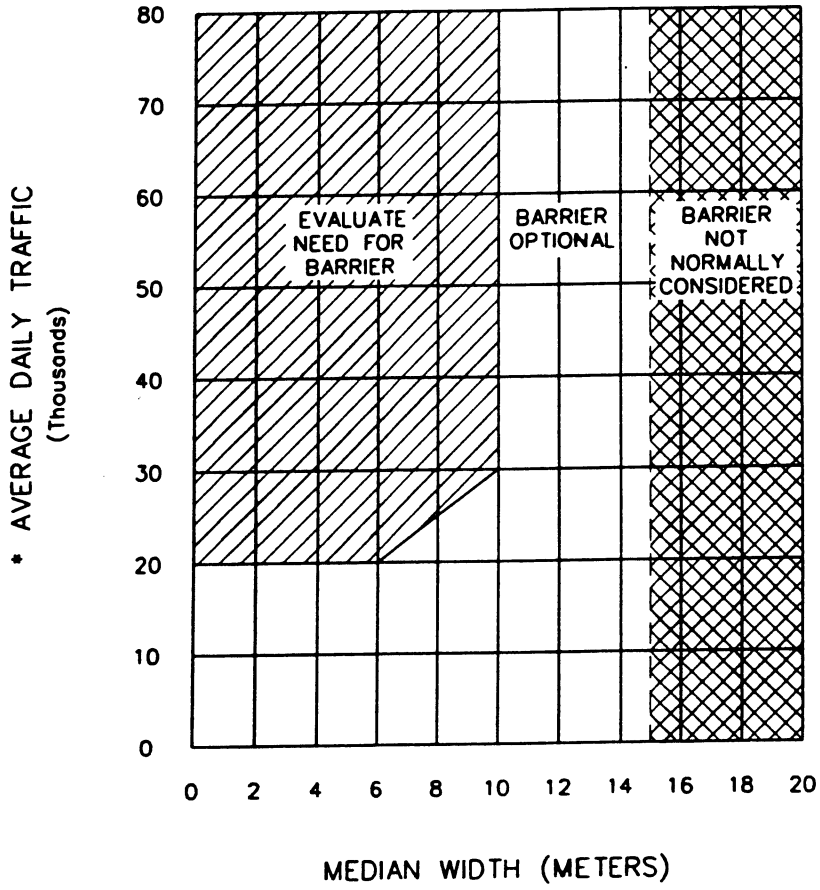
ATTACHMENT A





* Based on a 5 year projection

Source: AASHTO 1996 Roadside Design Guide

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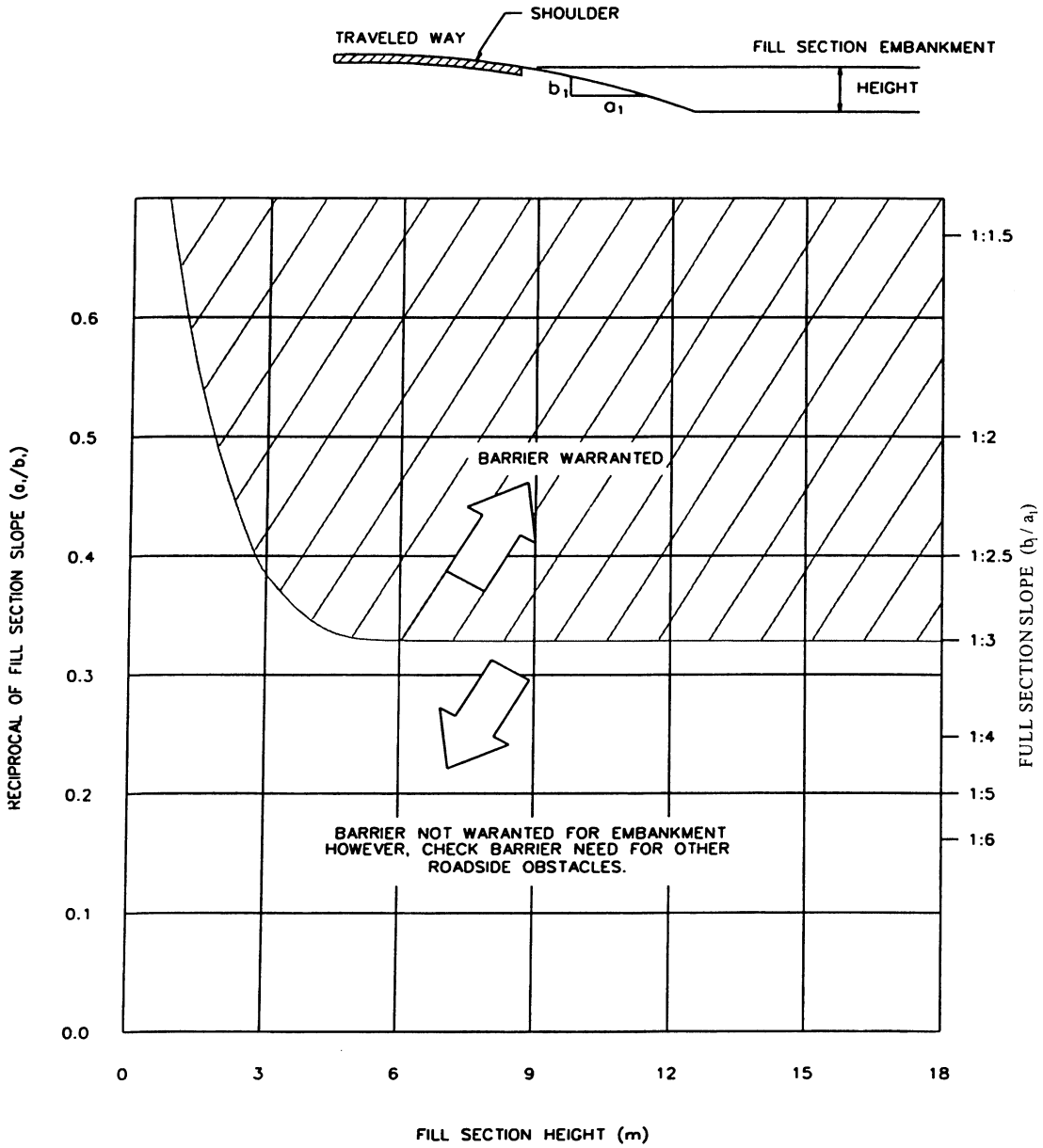
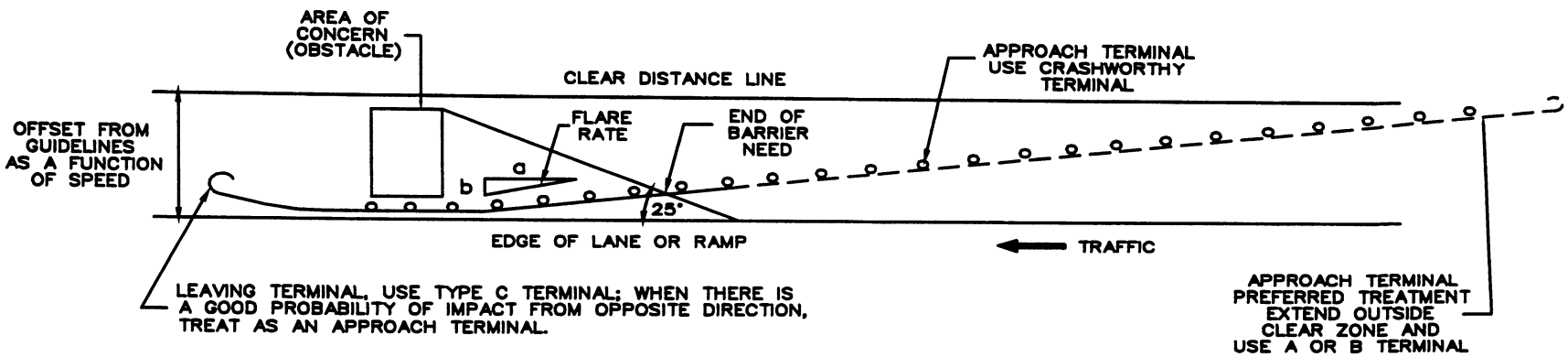
ATTACHMENT B



Comparative Risk Warrants for Embankments

Source: AASHTO 1996 Roadside Design Guide

ATTACHMENT C



BARRIER LAYOUT VARIABLES