SECTION A-2-CLEAR ZONE GUIDELINES

INTRODUCTION

If practicable, a traversable recovery area for errant vehicles should be provided beyond the edge of the traveled way (edge of mainline pavement) in order to improve highway safety. Ideally this recovery area or "clear zone" should be free of obstacles such as unyielding sign and luminaire supports, non-traversable drainage structures, utility poles and steep slopes. It must be noted that clear zone roadside design involves a series of compromises between "absolute" safety and "engineering, environmental and economic constraints." The following clear zone guidelines were developed using the 1989 AASHTO Roadside Design Guide.

The recommended width of clear zone as discussed in the Roadside Design Guide is influenced by the traffic volume, speed, and embankment slope (see TABLE A-2-1M). The Roadside Design Guide will be used as reference for determination of clear zones for Freeways; Rural and Urban Arterials (with shoulders); and Rural and Urban Collectors (with shoulders) with design speeds of 80 kph or greater and with design year ADT volumes greater than 2000. For Rural and Urban collectors with design speeds less than 80 kph and with a design year ADT less than 2000 and for Local Roads, no minimum required clear zone width will be specified; however, the designer should strive to provide as much clear zone as possible with a minimum 3.0 meter width being desirable. Projects such as RRR, intersection improvements, etc., would not normally be provided with recoverable areas due to the intent of the project to provide minimal improvements and extend the service life of an existing highway for a fraction of the costs of reconstruction or to provide necessary interim improvements.

When adequate right of way is available, urban projects should be designed with shoulders in lieu of curbs (unless city ordinances require otherwise) and they should have clear zone widths consistent with their design speeds, traffic volumes, and embankment slopes as noted in TABLE A-2-1M.

In urban and suburban areas where curb is utilized with a design speed of 70 kph or less, a 2.3 meter desirable and 1.8 meter minimum clear zone beyond the curb face is to be provided (see FIGURE A-2-1M). It is policy to place utility poles or other fixed objects outside the clear zone (beyond the sidewalk space or behind the curb in the case of a raised median). However, in rare instances this may be impractical due to prevailing limitations or conditions (example - relocation of utility poles to another corridor may not be economically feasible). When this occurs, an absolute minimum clear zone of 0.5 meters beyond the face of curb is to be provided. The justification for not providing the 2.3 meter desirable or 1.8 meter minimum clear zone width beyond the curb face is to be documented in the project file (e.g. - F.I. Report, memorandum from R/W Division Utility Section, etc.).

When mountable curb is used in urban areas it is desirable to provide the same clear zone as would be provided for with a rural condition. However, if those values cannot be obtained, the clear zone widths for 70 kph or less should be utilized.

TABLE A-2-1M Clear Zone Distances (In meters from edge of driving lane)

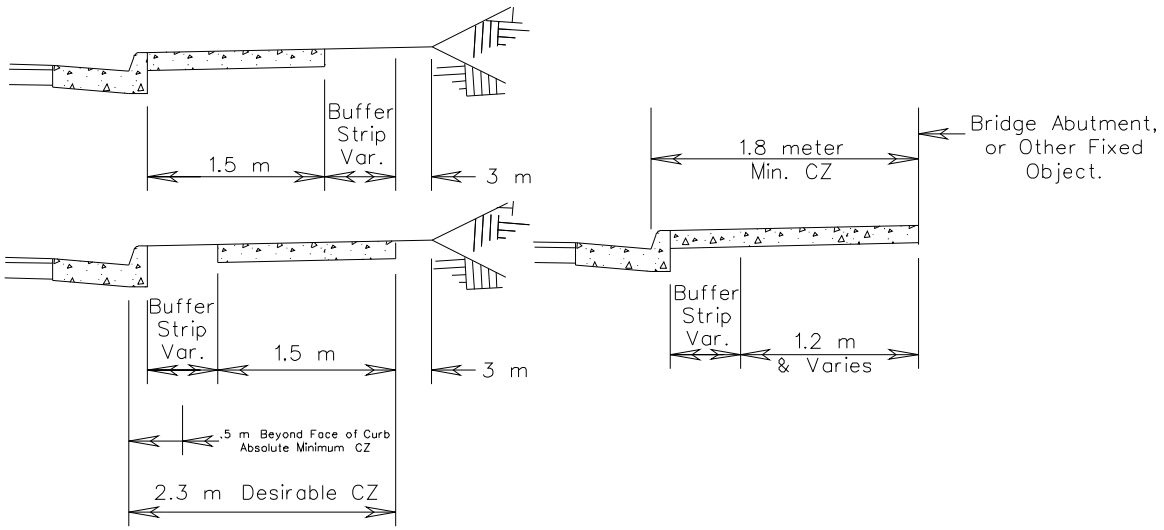
Design Speed	Design ADT	6 : 1 or flatter	5 : 1 to 4 : 1	3 : 1
60 km/h or less	Under 750	2.0 - 3.0	2.0 - 3.0	* *
	750 - 1500	3.0 - 3.5	3.5 - 4.5	* *
	1500 - 6000	3.5 - 4.5	4.5 - 5.0	* *
	Over 6000	4.5 - 5.0	5.0 - 5.5	* *
70 - 80 km/h	Under 750	3.0 - 3.5	3.5 - 4.5	* *
	750 - 1500	4.5 - 5.0	5.0 - 6.0	* *
	1500 - 6000	5.0 - 5.5	6.0 - 8.0	* *
	Over 6000	6.0 - 6.5	7.5 - 8.5	* *
90 km/h	Under 750	3.5 - 4.5	4.5 - 5.5	* *
	750 - 1500	5.0 - 5.5	6.0 - 7.5	* *
	1500 - 6000	6.0 - 6.5	7.5 - 9.0	* *
	Over 6000	6.5 - 7.5	7.9 - 10.0 *	* *
100 km/h	Under 750	5.0 - 5.5	6.0 - 7.5	* *
	750 - 1500	6.0 - 7.5	8.0 - 10.0 *	* *
	1500 - 6000	8.0 - 9.0	10.0 - 12.0 *	* *
	Over 6000	9.0 - 10.0 *	11.0 - 13.5 *	* *
110 km/h	Under 750	5.5 - 6.0	6.0 - 8.0	* *
	750 - 1500	7.5 - 8.0	8.5 - 11.0 *	* *
	1500 - 6000	8.5 - 10.0 *	10.5 - 13.0 *	* *
	Over 6000	9.0 -10.5 *	11.5 - 14.0 *	* *

* Where a site specific investigation indicates a high probability of continuing accidents, or such occurrences are indicated by accident history, the designer may provide clear zone distances greater than 9 meters as indicated. Clear zones may be limited to 9 meters for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

** Since recovery is less likely on the unshielded, traversable 3:1 slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high speed vehicles that encroach beyond the edge of shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should take into consideration right of way availability, environmental concerns, economic factors, safety needs, and accident histories. Also, the distance between the edge of the travel lane and the beginning of the 3:1 slope should influence the recovery area provided at the toe of slope. While the application may be limited by several factors, the fill slope parameters which may enter into determining a maximum desirable recovery area are illustrated in FIGURE A-2-4M on page A-40 (Metric).

Source: The 1989 AASHTO Roadside Design Guide.

FIGURE A-2-1M
URBAN CLEAR ZONE WIDTH GUIDELINES



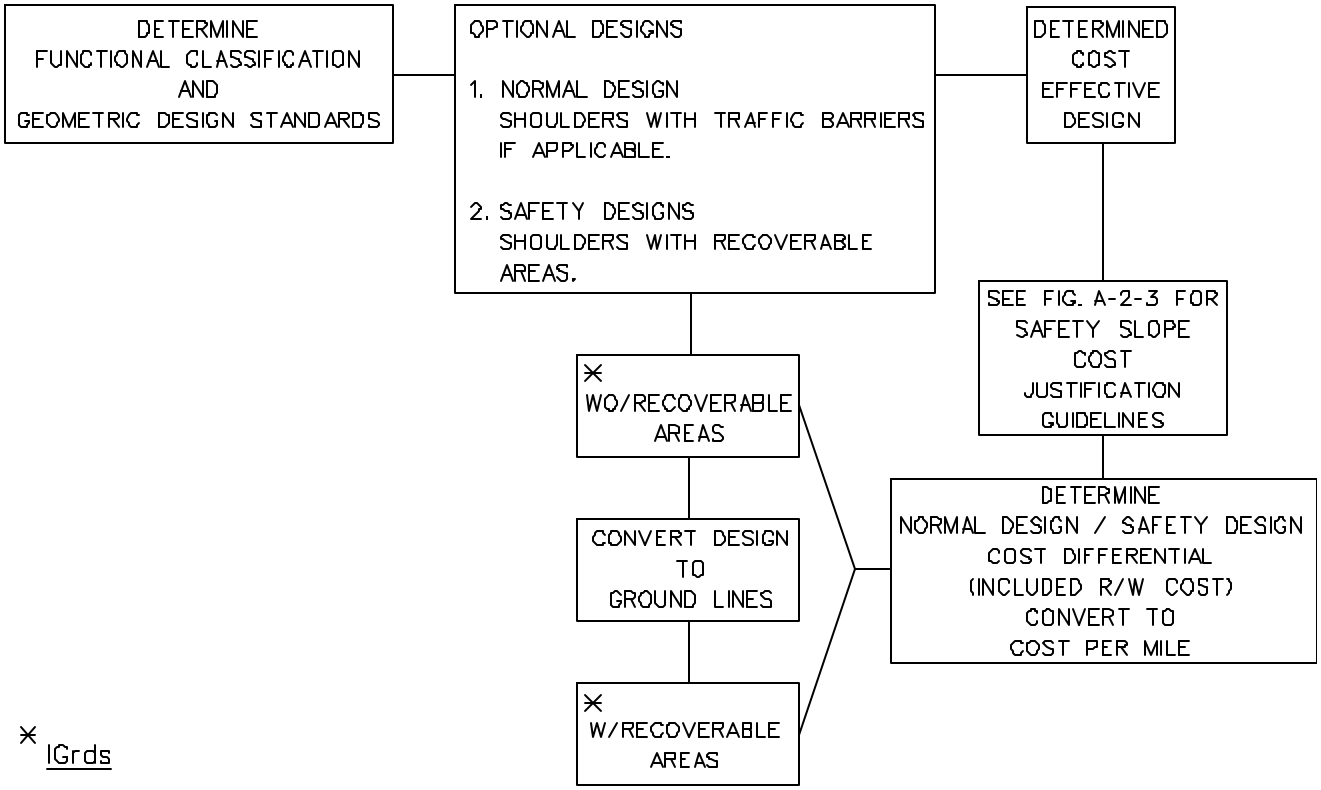
CLEAR ZONE COST-EFFECTIVENESS ANALYSIS

For projects where the clear zone widths from the AASHTO Roadside Design Guide are under consideration, Freeways; Rural and Urban Arterials (with shoulders); and Rural and Urban Collectors (with shoulders) with design speeds of 80 kph or greater and with a design year ADT greater than 2000, an early cost-effectiveness analysis is required to determine the feasibility of providing the recoverable areas to meet the clear zone requirements shown in TABLE A-2-1M. This analysis should be done during the preliminary plan development process and should involve determining the additional construction and R/W costs to provide the desired clear zone.

Prior to establishing the additional construction and R/W cost estimate, the developed areas that would involve heavy R/W damages and/or relocations or environmental restrictions such as park properties, historic areas or wetlands should be noted and where practicable horizontal and vertical alignment adjustments are to be made to provide the desired recoverable areas and clear zones. In these situations alternate designs may include elimination of ditches and/or median width reductions with possible incorporation of raised medians or median barrier to reduce required R/W.

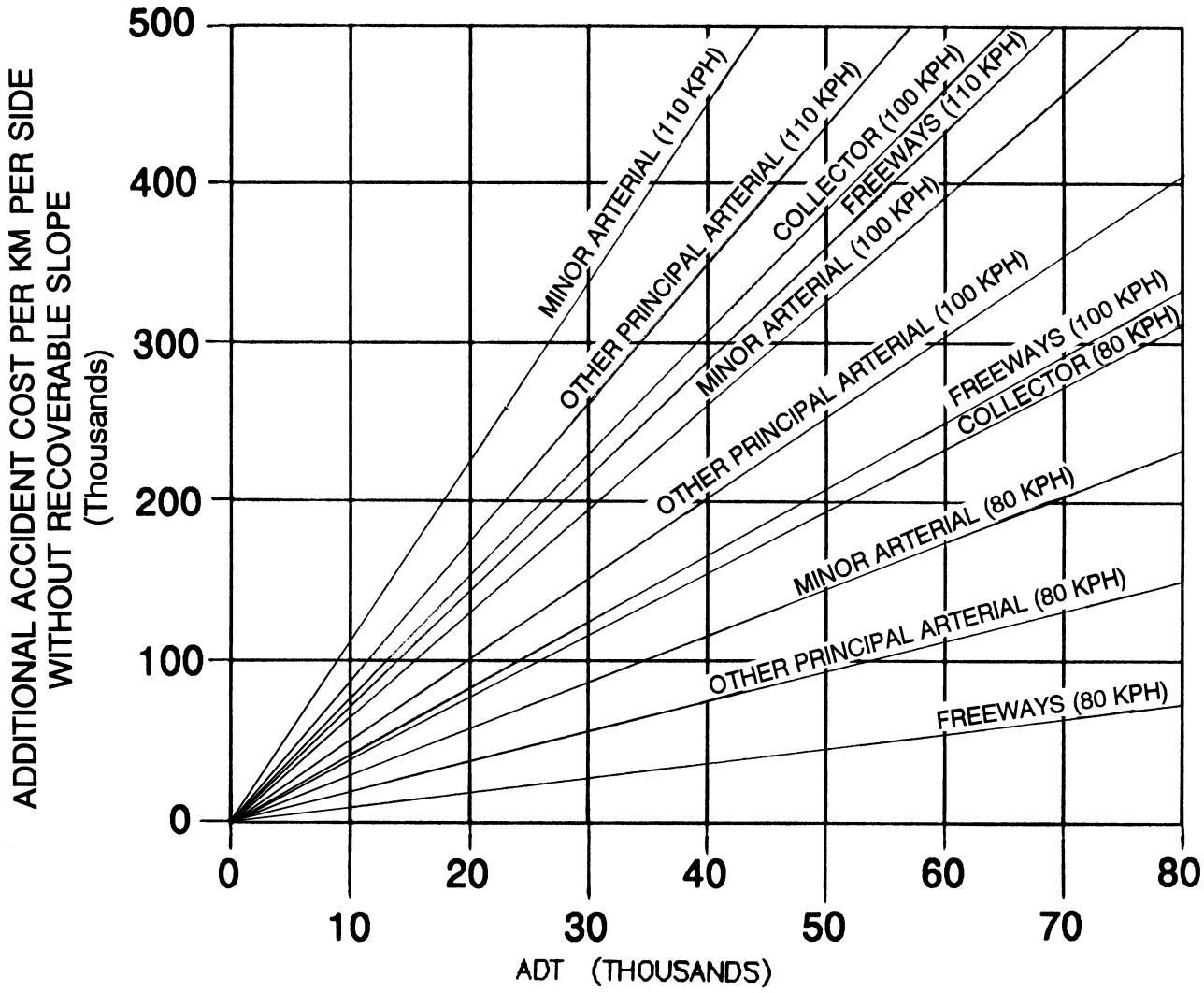
A suggested procedure is shown in FIGURE A-2-2M to develop the difference in cost between the typical section based on the project's functional classification and proper Geometric Design Standards and the typical section with the desired recoverable areas. Any other procedure which will provide this cost is acceptable as long as it is documented in the project files. After the additional cost to provide the recoverable area is determined, it should be compared to the estimated accident cost without the recoverable area as determined from FIGURE A-2-3M. This cost comparison along with good engineering judgment should be used to determine the feasibility of providing the recoverable areas through the project and should be documented on the Project Scoping Form LD-403 or SR-1 as applicable.

FIGURE A-2-2 M
COST EFFECTIVE SELECTION PROCEDURE



Note: Upon receipt of Normal Design and Safety Design earthwork quantities, a cursory review may indicate that the cost per kilometer per side for the earthwork alone far exceeds the Guideline for Maximum Cost per kilometer Expenditure for Safety Slopes in Figure A-2-3M, thereby eliminating the need to determine the other additional cost such as drainage extensions, right of way, etc.

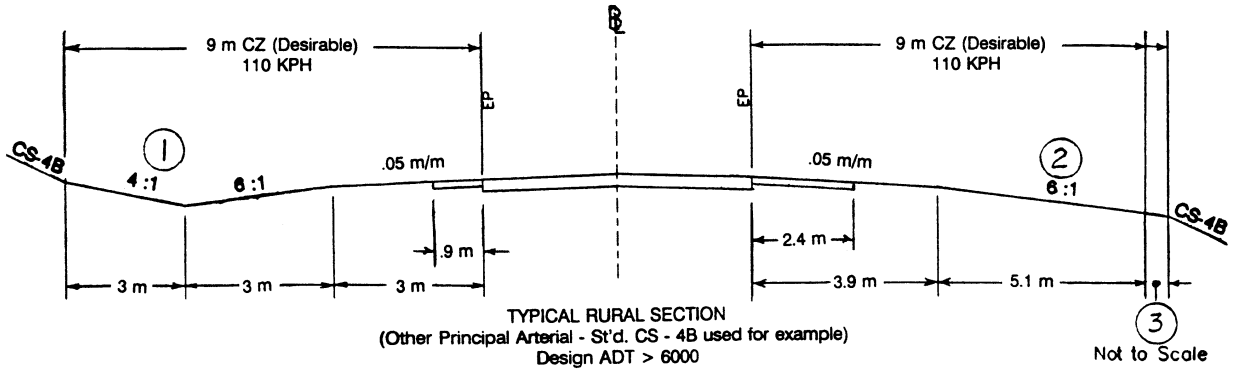
FIGURE NO. A-2-3M
SAFETY SLOPE COST JUSTIFICATION GUIDELINES



EXAMPLES OF COST PER SIDE EXPLANATION ON OTHER PRIN. ARTERIAL (100 KPH)	
UNDIVIDED DESIGN ADT= 6,000	
SIDE	SIDE
$25,000 PER KM	$25,000 PER KM
DIVIDED DESIGN ADT= 10,000	
SIDE	SIDE
$50,000 PER KM	$50,000 PER KM

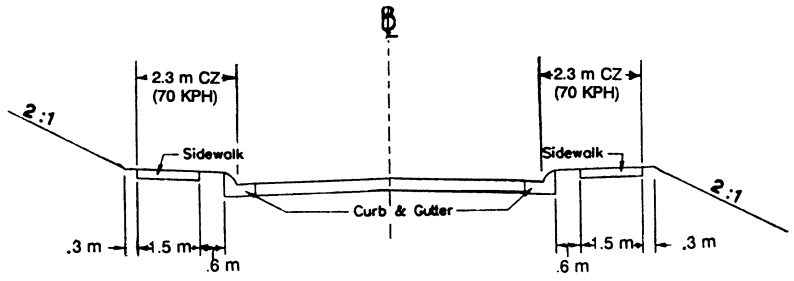
SHOWING CLEAR ZONES ON TYPICAL SECTIONS

The clear zone width(s) is to be clearly shown on the project typical sections if traversable slopes are being provided so that other divisions will be aware of the desirable clear zones for a project. When varying clear zone widths occur, furnish station to station breakdown. Following are typical methods of showing clear zone data on typical sections.



TYPICAL RURAL SECTION
(Other Principal Arterial - St'd. CS - 4B used for example)
Design ADT > 6000

Not to Scale



TYPICAL URBAN SECTION
(Minor Arterial Street used for example)

Not to Scale

TYPICAL METHOD
OF SHOWING CLEAR ZONE DATA
ON TYPICAL SECTIONS

NOTES:

1. If the front slope of ditch is 6:1, the back slope should be 4:1, and if the front slope is 3:1, the back slope should be flat.

2. The preferred slope for recoverable areas with fills is 6:1 or flatter.

3. Recoverable area width to be increased 1 meter if GR-3 or 8 guardrail is required.

DETERMINING CLEAR ZONE WIDTH

The following is a guide and should be supplemented with sound engineering judgment:

Clear zone (CZ) is defined as the roadside border area, starting at the edge of the traveled way (edge of mainline pavement), available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope 4:1 or flatter, a non-recoverable slope between 4:1 and 3:1, and/or a clear run-out area. Previously, 9 m was considered to be the standard clear zone, but current guidelines, as shown in TABLE A-2-1M, give values greater or less than 9 m, depending on the roadside slopes, design speeds, and traffic volumes. These values should suggest only the approximate center of a range to be considered and not a precise distance to be held as absolute.

TABLE A-2-1M is to be used by the designer and may be modified by the values shown in TABLE A-2-2M. See the 1989 AASHTO Roadside Design Guide for further details.

Embankment slopes must have a relatively smooth and firm surface to be truly recoverable or traversable.

Fill slopes between 3:1 and 4:1 are non-recoverable slopes, defined as one which is traversable, but from which most motorists will be unable to stop or to return to the roadway easily. Vehicles on such slopes typically can be expected to reach the bottom. Since a high percentage of encroaching vehicles will reach the toe of these slopes, the recovery area cannot logically end on the slope. Fixed obstacles should not be constructed along such slopes and a clear runout area (3 m min.) at the base is desirable. Figure A-2-4M on page A-40 (Metric) provides an example of a clear zone computation for non-recoverable slopes.

Any non-traversable hazards or fixed objects, including but not limited to those listed in TABLE A-3-1M, page A-44 (Metric) which are located within the clear zone as determined from TABLE A-2-1M, should preferably be removed, relocated, made yielding, or as a last resort, shielded with a barrier.

HORIZONTAL CURVE ADJUSTMENTS

These modifications are normally only considered where accident histories indicate a need, or a specific site investigation shows a definitive accident potential which could be significantly lessened by increasing the clear zone width and such increases are cost effective.

TABLE A-2-2M

(K_{cz}) (Curve Correction Factor)

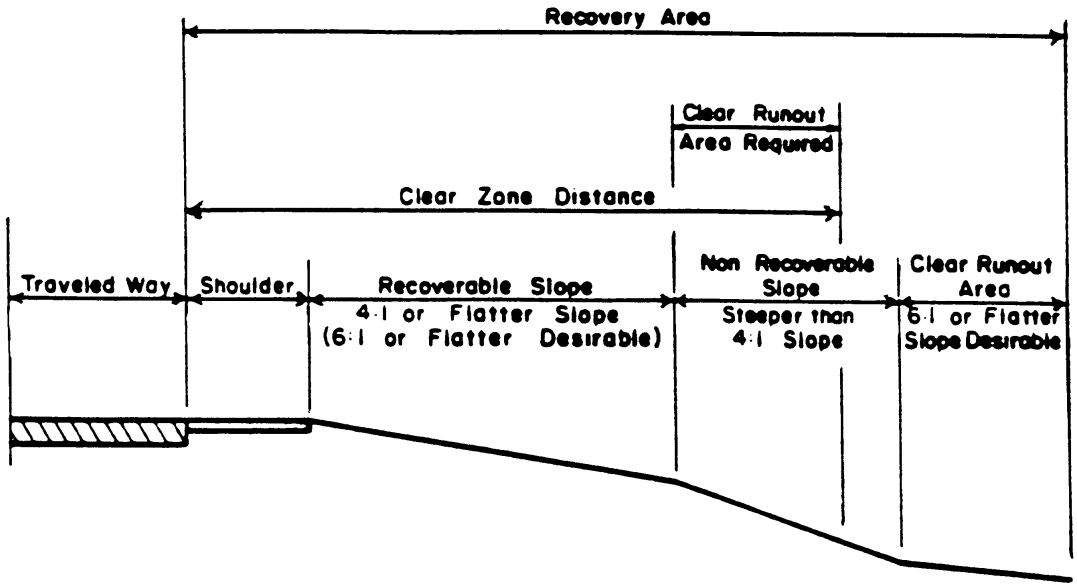
CURVE RADIUS (METERS)	DESIGN SPEED					
	60	70	80	90	100	110
900	1.1	1.1	1.1	1.2	1.2	1.2
700	1.1	1.1	1.2	1.2	1.2	1.3
600	1.1	1.2	1.2	1.2	1.3	1.4
500	1.1	1.2	1.2	1.3	1.3	1.4
450	1.2	1.2	1.3	1.3	1.4	1.5
400	1.2	1.2	1.3	1.3	1.4	1.4
350	1.2	1.2	1.3	1.4	1.5	
300	1.2	1.3	1.4	1.5	1.5	
250	1.3	1.3	1.4	1.5		
200	1.3	1.4	1.5			
150	1.4	1.5				
100	1.5					

$CZ_c = (L_c)\ (K_{cz})$ K_{cz} = curve correction factor

Where CZ_c = clear zone on outside of curvature, ft.
L_c = clear zone distance ft., Table A-2-1M

Note: Clear zone correction factor is applied to outside of curves only. Curves with radius greater than 875 meters don't require an adjusted clear zone.

FIGURE A-2-4M Example of a Parallel Embankment Slope Design



Source: The 1989 AASHTO Roadside Design Guide.

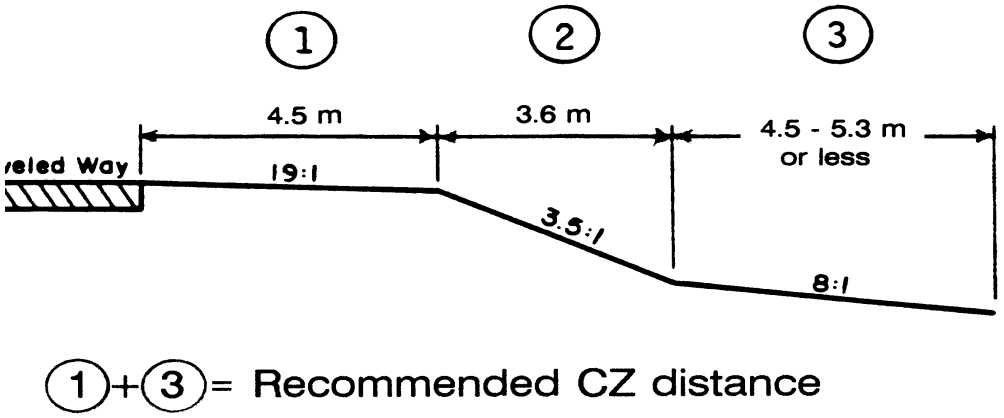
This figure illustrates a recoverable slope followed by a non-recoverable slope. Since the clear zone distance extends onto a non-recoverable slope, the portion of the clear zone distance on such a slope may be provided beyond the non-recoverable slope if practical. This clear runout area would then be included in the total recovery area. The clear runout area may be reduced in width based on existing conditions or site investigations. Such a variable slope typical section is often used as a compromise between roadside safety and economics. By providing a relatively flat recovery area immediately adjacent to the roadway, most errant motorists can recover before reaching the steeper slope beyond. The slope break may be liberally rounded so an encroaching vehicle does not become airborne. It is suggested that the steeper slope be made as smooth as practical and rounded at the bottom.

NON-RECOVERABLE PARALLEL SLOPES

Embankment slopes from 3:1 up to 4:1 are considered traversable if they are smooth and free of fixed object hazards. However, since many vehicles on slopes this steep will continue on to the bottom, a clear run-out area beyond the toe of the slope is desirable. The extent of this recovery area could be determined by first finding the available distance between the edge of the traveled way and the breakpoint of the recoverable slope to the non-recoverable slope. This distance is then subtracted from the total recommended clear zone distance based on the slope that is beyond the toe of the non-recoverable slope. The result is the desirable clear run-out area. The following example illustrates this procedure:

EXAMPLE

Design ADT: 7000
Design Speed: 100 kph
Recommended clear zone distance for the 8:1 slope: 9 - 9.8 m (from TABLE A-2-1)
Recovery distance before breakpoint of slope: 4.5 m
Clear runout area at toe of slope: 9.0 - 9.8 m minus 4.5 m or 4.5 - 5.3 m



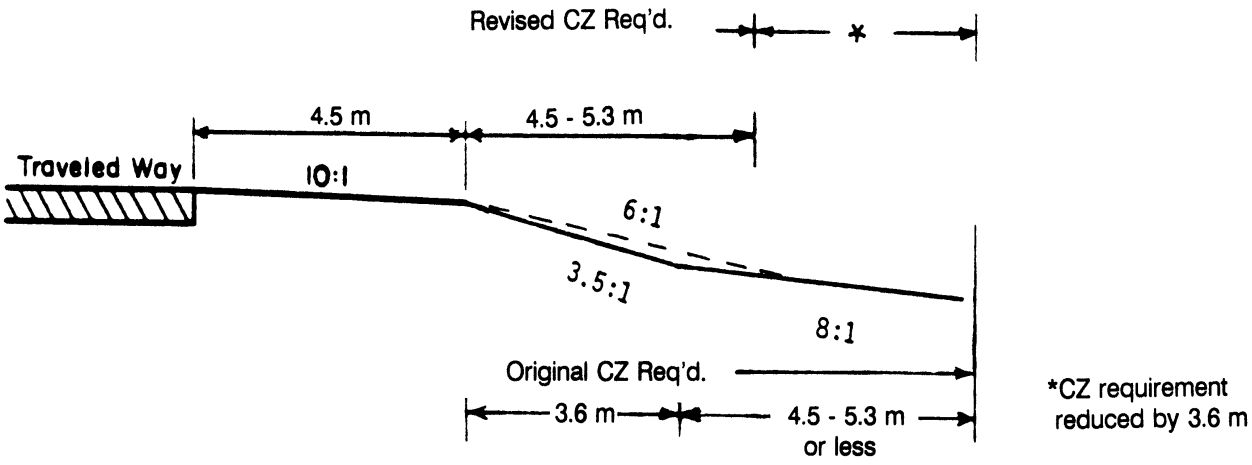
(1)+(3)= Recommended CZ distance

(For Example of Alternate Design to reduce CZ requirement, see below)

Discussion: Using the steepest recoverable slope before or after the non-recoverable slope, a recovery distance is selected from Table A-2-1M. In this example, the 8:1 slope beyond the base of the fill dictates a 9.0 - 9.8 m recovery area. Since 4.5 m are available at the top, an additional 4.5 - 5.3 m could be provided at the bottom. All slope breaks may be rounded and no fixed objects would normally be built within the upper or lower portions of the clear zone or on the intervening slope.

The designer may find it safe and practical to provide less than the entire 4.5 - 5.3 m at the toe of the slope. A smaller recovery area could be applicable based on the rounded slope breaks, the flatter slope at the top, or past accident histories. A specific site investigation may be appropriate in determining an appropriate recovery area at the toe of the slope.

Example of Alternate Design (incorporating minor slope adjustment) to reduce total clearance requirement.



When traffic barriers must be provided because hazardous conditions can not be eliminated, see Section A-3-Barrier Installation Criteria.