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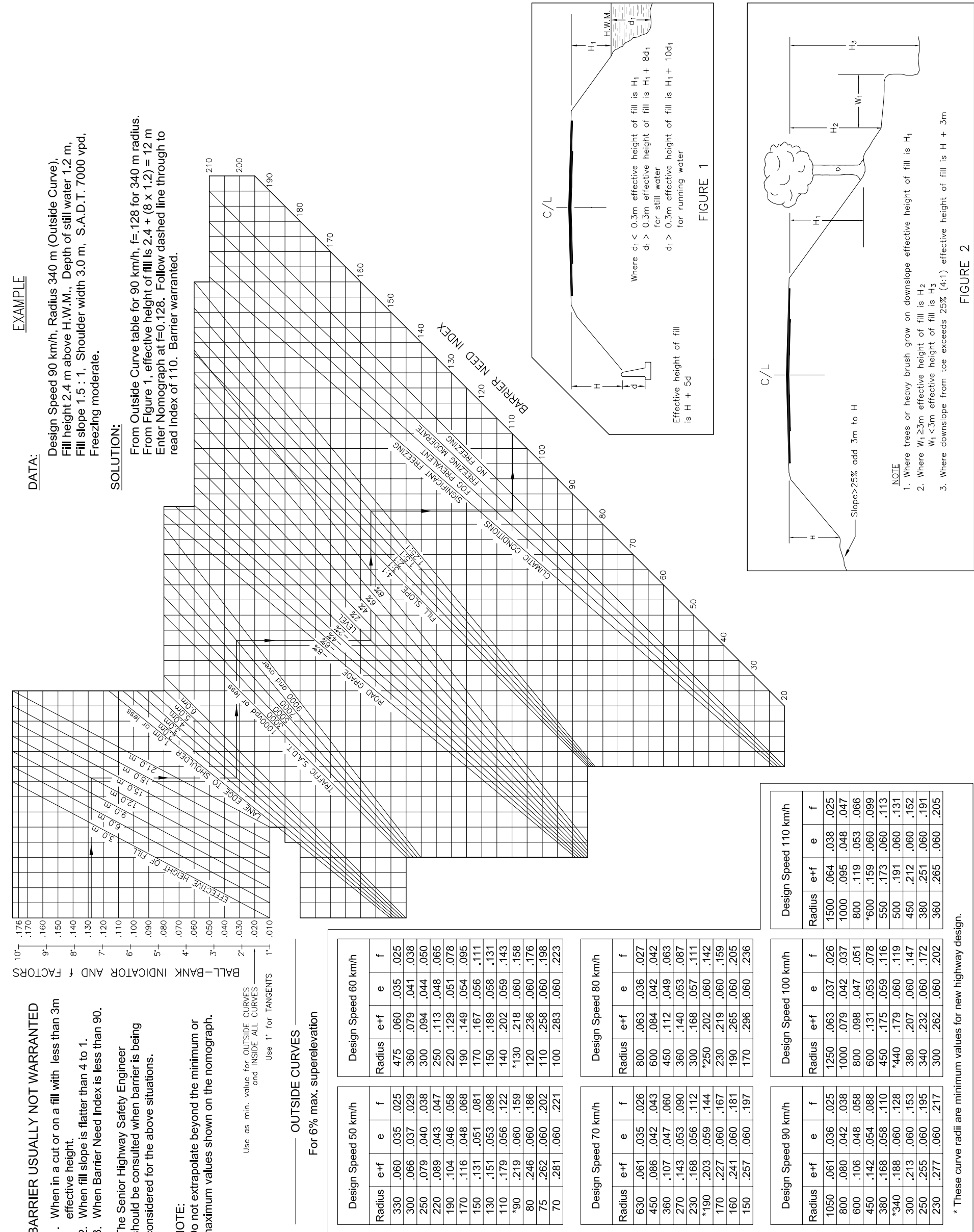
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Figure 610.A Roadside Barrier Index Nomograph  
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## 620 ROADSIDE SAFETY

### 620.01 INTRODUCTION

In highway design, the term Roadside Safety encompasses the area outside the travel portion of the roadway. This includes the shoulder, the side slopes, ditches and any fixed objects and water bodies that could present a serious hazard the occupants of a vehicle leaving the roadway.

Within the limits of the project's scope and budget, the highway designer has some measure of control in shaping the roadside environment to reduce roadside hazards.

The following clarifies the British Columbia Ministry of Transportation's design policy on the application of the most important design element of Roadside Safety which is called the Clear Zone.

This chapter supplements the Transportation Association of Canada's Geometric Design Guide for Canadian Roads which is the main reference manual used by the British Columbia Ministry of Transportation.

### 620.02 FORGIVING ROADSIDE

The designer should strive to achieve the "*Forgiving Roadside*". The following quote, taken from Transportation Research Board Circular 435, outlines the essence of the design concept that incorporates Roadside Safety:

*"Basically, a forgiving roadside is one free of obstacles that could cause serious injuries to occupants of an errant vehicle. To the extent possible, a relatively flat, unobstructed roadside recovery area is desirable, and when these conditions cannot be provided, hazardous features in the recovery area should be made breakaway or shielded with an appropriate barrier."*

### 620.03 CLEAR ZONE

The Clear Zone includes the total roadside border area, starting at the edge of the outer through lane edge. This area shall consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent

upon the design traffic volume and speed and on the roadside geometry"

Note: Recovery zone is another term that is used interchangeably with clear zone.

### 620.04 DEFINITIONS

**Average Annual Daily Traffic (AADT)**: Refer to the definition on page 3 of the glossary. The AADT for the design year should be used.

**Back slope**: Graded uphill slope up to the original ground and beyond the ditch in a cut. Sometimes written in one word as a "backslope" or referred to as a "cut slope".

**Clear runout area**: The area located beyond the toe of a non-recoverable slope that is free of fixed objects and available for an errant vehicle to come to a rest.

**Clear zone distance**: Distance in metres measured at ninety degrees from the outer through lane edge in the direction away from the traveled way. Within the boundaries outlined by the clear zone distance are usually the shoulder and a recoverable slope. In some situations a non-recoverable slope and/or a clear runout area may also be located within the clear zone distance.

**Critical fill slope**: Any fill slope steeper than 3:1. An errant vehicle traversing a critical fill slope is at much greater risk to overturn than on slopes at 3:1 or flatter.

**Cut slope**: See "Back slope".

**Design Clear zone distance**: The target value used for a specific highway design when the design speed and the design volume are known. This value is obtained from Table 620.A.

**Fill slope**: See "Front slope".

**Fixed objects**: Refer to section 620.06 item # 2.

**Front slope**: Graded downhill slope beyond the outside edge of the shoulder down to the ditch in a cut or to the original ground on a fill. This is sometimes called a "fill slope" or a "foreslope".

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**Hazard:** A critical slope, fixed object, or body of water which, when hit or reached by a vehicle, may either cause the vehicle to overturn and/or injure occupants of the vehicle.

**Major Reconstruction:** For the purposes of this chapter, “major reconstruction” includes projects on existing highways that involve grading works to improve capacity.

**New Construction:** For the purpose of this chapter - Construction of a new highway horizontal or vertical alignment.

**Non-recoverable slope:** A slope on which an errant vehicle will continue until it reaches the bottom, without having the ability to recover control. Fill slopes steeper than 4:1, but no steeper than 3:1, are considered non-recoverable.

**Recoverable slope:** A slope on which the driver of an errant vehicle can regain control of the vehicle. Slopes that are 4:1 or flatter are considered recoverable.

**Recovery zone:** The target area used in highway design when a fill slope between 4:1 and 3:1 is used within the design clear zone distance.

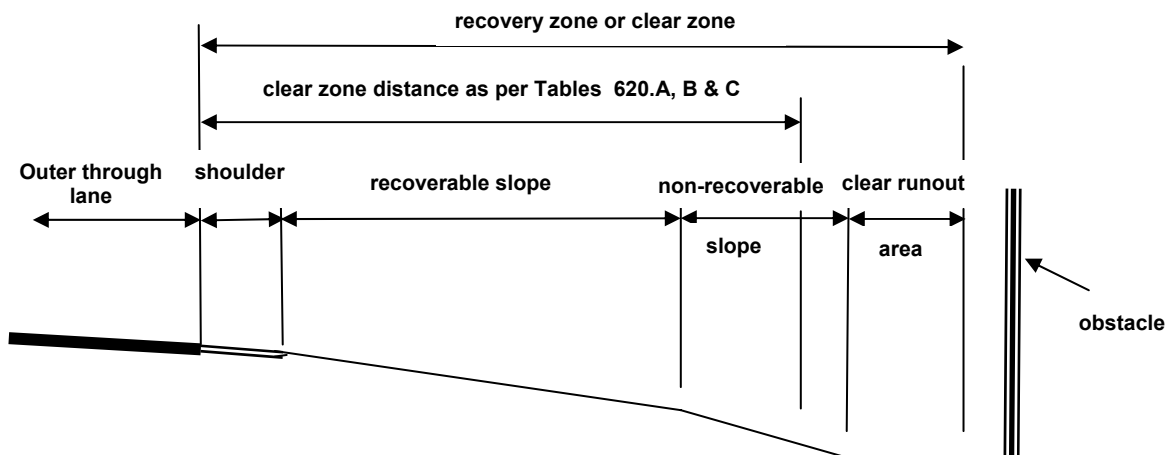
**Rehabilitation:** Often called 3R for resurfacing, restoration, rehabilitation, is to restore the existing highway to its initial condition. The project may include some safety enhancements. The primary objective of projects falling under a 3R program is to extend the service life and improve safety of an existing highway.

**Traveled way:** That part of a roadway intended for vehicle traffic. This excludes shoulders, parking lanes, rest areas and bus bays.

## 620.05 COMPONENTS OF CLEAR ZONE

Figure 620.A shows the components of the roadside Clear Zone using the TAC definitions. If the clear zone distance ends on a non-recoverable slope, a clear runout area is required. The desirable width of this area shall be equal to the portion of the clear zone distance overlapping the non-recoverable slope and typically should be a minimum of 2.0 m beyond the toe. Refer to Tables 620.A, B & C for Clear Zone distances. Also refer to note (\*\*) in Table 620.A. The clear zone distance should preferably be located entirely within a recoverable slope thereby eliminating the need for a clear runout area.

**Figure 620 .A Components of the Clear Zone design element**



Source: Transportation Association of Canada, Geometric Design Guide for Canadian Roads, September 1999.

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## 620.06 ROADSIDE DESIGN METHODS FOR NEW CONSTRUCTION AND MAJOR RECONSTRUCTION

New construction and major reconstruction are defined in section 620.04. The designer should refer to the Roadside Safety chapter of the TAC Geometric Design Guide for Canadian Roads for factors influencing the Clear Zone Design Domain and examples of calculations on shaping the side slopes for the area enclosed within the recovery zone.

This section clarifies BC MoT's policy on the treatment of hazards and mitigation methods within the recovery zone.

The first step is to identify the suggested clear zone distance as a function of the project design speed and the estimated design year volume for a selected slope. In the area enclosed within the clear zone distance, there are three general categories of hazards that the designer should remove or mitigate: side slopes, fixed objects and bodies of water.

The designer must evaluate the potential risks presented by these hazards and proceed with any of these options in descending order of desirability based on an optimum net present value analysis:

- i) Design the side slopes according to the Clear Zone Guidelines;
- ii) Remove any hazard within the recovery zone;
- iii) Shield the hazard with safety barrier or crash cushion;
- iv) Use break-away devices or posts;
- v) Take no action if all of the above actions are not cost effective (usually only considered on lower volume roads that are less than 750 AADT and/or low speed facilities with posted speeds of less than 60 km/h). However, in such a case, the obstacle should be properly delineated.

Shoulder Rumble Strips are not a substitute for clear zone design. Therefore, they cannot be used a reason to justify a reduction of the clear zone distance.

### 1) Highway Cross-section Slopes

#### A. Fill or Front Slopes

The designer should preferably design fill slopes of between 10:1 and 6:1. The minimum fill slope is 4:1. Fill slopes steeper

than 4:1 are non-recoverable and require special attention from the designer to provide specific measures in the design to mitigate the hazard presented by such slope.

#### B. Cut or Back Slopes

Cut slopes of 3:1 and flatter that are free of fixed objects are usually less severe a hazard than a traffic barrier. In the case of a rock cut, it should either be outside the clear zone or shielded by a roadside barrier.

The designer should conduct an individual analysis for each rock cut or group of rocks cuts and document the reasons justifying the roadside safety design decision.

#### C. Transverse Slopes and Culvert Ends

Roadway features that introduce a transverse slope or exposed face within the clear recovery zone must either be shielded or designed to be traversable. These roadway features typically include: driveways, turnarounds in depressed median and earth berms.

Traversable transverse slope treatments are applied for slopes facing oncoming traffic on divided highways and on both sides for undivided highways. The designer should refer to the latest edition of the TAC Geometric design Guide for Canadian Roads for detailed design parameters to be used for transverse slopes and culvert end treatments within the clear zone.

### 2) Fixed Objects

The following are typical examples of fixed objects that require special analysis by the designer for roadside safety mitigation treatment:

- Non breakaway posts and light standards (note: all posts should be analysed including tall electrical power line posts as well as simple posts that support signs or mail boxes. Fire hydrants that are made of cast iron which will easily fracture on impact are considered as breakaway. Any other part of the base of a fire hydrant that is not frangible must not protrude more than 100 mm above ground);

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- Trees which have a potential of growing to a diameter that exceeds 100 mm measured 150 mm above ground level;
- Any fixed object protruding more than 100 mm above ground. This includes but is not limited to boulders, curbs, culverts and pipe ends.
- Fencing should preferably be located outside the clear recovery zone or be designed and installed in a manner that will make it yield on impact without producing debris that could penetrate the errant vehicle and injure occupants. Refer to section 660 for guidelines to provide fencing for pedestrians and cyclists.

### 3) Water Bodies and High Fills

Regardless of the barrier need index obtained from Figure 610.A, the designer should analyze the risk presented by the following potential hazards when these are located within 15 m of the outside edge of the through traffic lane:

- water bodies with a permanent water depth of 300 mm or more
- slopes steeper than 3:1 exceeding a height of 3 m

## 620.07 COST-EFFECTIVENESS METHODOLOGY

Utilizing a cost-effectiveness approach will allow the Ministry to optimize the allocation of its resources to achieve better safety for the traveling public throughout the overall Provincial roadway system.

Further discussion on the explicit analysis of roadside safety features may be found in the TAC Geometric Design Guide for Canadian Roads, section 3.1.2.

Appendix A of the AASHTO Roadside Design Guide describes a cost-effectiveness methodology called Roadside Safety Analysis Program (RSAP). Copies of the NCHRP Report 492 Engineer's Manual, RSAP User's Manual and the RSAP program can be downloaded free from the TRB Web site at: <http://www.trb.org/TRB/Publications/Publications.asp>

## 620.08 PREAMBLE ON CLEAR ZONE DISTANCES

The Clear Zone Distances in Tables 620.A and 620.B in the following pages, are from AASHTO and TAC documents (see section 620.14 REFERENCES). The reduced Clear Zone distances in Table 620.C were adopted by BC MoT in 1995 based on a benefit-cost analysis

As stated in the AASHTO Roadside Design Guide: These tables “*only provide a general approximation of the needed clear zone distance*”. They are “*based on limited empirical data that was extrapolated to provide information for a wide range of conditions, design speeds, rural versus urban locations, and practicality*”.

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**Table 620.A Suggested <sup>(\*)</sup> Design Clear Zone Distances <sup>(see note 1)</sup> in metres**  
**For New Construction and Reconstruction Projects on Rural Highways <sup>(\*\*)</sup>**

Design Speed (km/h)	Design Year AADT (see note 2)	Front Slopes (Fill)			Back Slopes (Cut) <sup>(see note 4)</sup>		
		6:1 or flatter	5:1 to 4:1	3:1	3:1	5:1 to 4:1	6:1 or flatter
< 70	200 < AADT < 750 (see note 3)	2.0 – 3.0	2.0 – 3.0	**	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0
	750 – 1500	3.0 – 3.5	3.5 – 4.5	**	3.0 – 3.5	3.0 – 3.5	3.0 – 3.5
	1501 – 6000	3.5 – 4.5	4.5 – 5.0	**	3.5 – 4.5	3.5 – 4.5	3.5 – 4.5
	> 6000	4.5 – 5.0	5.0 – 5.5	**	4.5 – 5.0	4.5 – 5.0	4.5 – 5.0
70 – 80	200 < AADT < 750 (see note 3)	3.0 – 3.5	3.5 – 4.5	**	2.5 – 3.0	2.5 – 3.0	3.0 – 3.5
	750 – 1500	4.5 – 5.0	5.0 – 6.0	**	3.0 – 3.5	3.5 – 4.5	4.5 – 5.0
	1501 – 6000	5.0 – 5.5	6.0 – 8.0	**	3.5 – 4.5	4.5 – 5.0	5.0 – 5.5
	> 6000	6.0 – 6.5	7.5 – 8.5	**	4.5 – 5.0	5.5 – 6.0	6.0 – 6.5
90	200 < AADT < 750 (see note 3)	3.5 – 4.5	4.5 – 5.5	**	2.5 – 3.0	3.0 – 3.5	3.0 – 3.5
	750 – 1500	5.0 – 5.5	6.0 – 7.5	**	3.0 – 3.5	4.5 – 5.0	5.0 – 5.5
	1501 – 6000	6.0 – 6.5	7.5 – 9.0	**	4.5 – 5.0	5.0 – 5.5	6.0 – 6.5
	> 6000	6.5 – 7.5	8.0 – 10.0*	**	5.0 – 5.5	6.0 – 6.5	6.5 – 7.5
100	200 < AADT < 750 (see note 3)	5.0 – 5.5	6.0 – 7.5	**	3.0 – 3.5	3.3 – 4.5	4.5 – 5.0
	750 – 1500	6.0 – 7.5	8.0 – 10.0*	**	3.5 – 4.5	5.0 – 5.5	6.0 – 6.5
	1501 – 6000	8.0 – 9.0	10.0 – 12.0*	**	4.5 – 5.5	5.5 – 6.5	7.5 – 8.0
	> 6000	9.0 – 10.0*	11.0 – 13.5*	**	6.0 – 6.5	7.5 – 8.0	8.0 – 8.5
≥ 110	200 < AADT < 750 (see note 3)	5.5 – 6.0	6.0 – 8.0	**	3.0 – 3.5	4.5 – 5.0	4.5 – 5.0
	750 – 1500	7.5 – 8.0	8.5 – 11.0*	**	3.5 – 5.0	5.5 – 6.0	6.0 – 6.5
	1501 – 6000	8.5 – 10.0*	10.5 – 13.0*	**	5.0 – 6.0	6.5 – 7.5	8.0 – 8.5
	> 6000	9.0 – 10.5*	11.5 – 14.0*	**	6.5 – 7.5	8.0 – 9.0	8.5 – 9.0

(\*) The designer may use lesser values than the suggested distances in this table only if these lesser values are justified using a cost-effectiveness analysis as outlined in section 620.07. The Design Clear Zone Inventory form in Figure 620.B must be filled-in by the designer and included in the design folder.

(\*\*) Rural highways are typically open ditch. Urban highways typically have curb and gutter with enclosed drainage. Refer to section 620.12 for a discussion of Clear Zone applied to an urban environment.

(\*) Clear zones may be limited to 9.0 metres 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 the 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 need and collision history. Also, the distance between the edge of the through 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 foreslope parameters which may enter into determining a maximum desirable recovery area are illustrated in Figure 620.A.

- Notes:**
- All distances are measured from the outer edge of the through traveled lane. Where a site specific investigation indicates a high probability of continuing crashes, or such occurrences are indicated by crash history, the designer may provide clear zone distances greater than the clear zone shown in Table 620.A.
  - For clear zones, the "Design Year AADT" will be total AADT for both directions of travel for the design year. This applies to both divided and undivided highways.
  - For AADT ≤ 200, the front slope is 2:1 or flatter, the back slope is 1.5:1 or flatter. The setback to fixed objects is the greater of the following two distances: - 4.0 m from the outside edge of the traveled lane or - 2.0 m from the lowest ditch point.
  - The values for "back slopes" only apply to a section where the toe of the slope is adjacent to the shoulder (enclosed drainage).
  - The values in the table apply to tangent sections of highway. Refer to Table 620.B for adjustment factors on horizontal curves.
  - Refer to the TAC Geometric Design Guide for Canadian Roads for worked examples of calculations.



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**Table 620.B Horizontal Curve Adjustment Factors for Clear Zone Distances ( $K_{CZ}$ )**

Radius (m)	Design Speed (km/h)					
	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	
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					

**Notes:**

- Adjustments apply to the outside of a horizontal curve only.
- No adjustment is warranted for curves that have a radius exceeding 900 metres.
- The applicable clear zone distance on a horizontal curve is given by the following formula:  
 $CZ_c = (K_{CZ})(CZ_t)$   
 where:  $CZ_c$  = clear zone distance on the outside of a curve in metres.  
 $K_{CZ}$  = curve adjustment factor from Table 620.B.  
 $CZ_t$  = clear zone distance used on a tangent section as per Table 620.A.  
 Rounding of the calculated Clear Zone distance is to the next higher 0.5 metre increment.
- Use straight-line interpolation to calculate the adjustment factor for a curve radius other than those listed in the table.
- The transition from  $Z_t$  on tangent to  $CZ_c$  in the curve is done by gradually increasing the Clear Zone over the length of the spiral.
- Also refer to the TAC Geometric Design Guide for Canadian Roads for worked examples of calculations.

## 620.09 DEPRESSED MEDIAN TREATMENT

The British Columbia Ministry of Transportation has been using a minimum standard depressed median width of 13 metres. This width is the minimum width on four lane divided highways that will allow for adding lanes on the inside to achieve the standard 5.6 metre wide narrow median (two 2.5 m wide inside shoulders and a 0.6 m wide standard concrete median barrier) on a six lane divided highway.

The 13 metres depressed median is a minimum dimension. In some cases, such as on horizontal curves that have a radius between the minimum for the design speed and minimum plus 15%, the designer should consider a wider median. The desirable median width in such a case is the calculated clear recovery area multiplied by 1.5. On

current highways that were built with a median width less than 1.5 times the calculated clear recovery zone distance, the designer should review the collision history to estimate the potential risk of head-on collisions at various locations and most particularly on curves. Typical mitigating measures recommended for locations with high potential of cross-over collisions are: - to widen the median or, as it is often more convenient; - to install on the edge of the shoulder on the outside of the curve or at another appropriate place within the wide median a flexible barrier (such as the high tension wire rope safety fence) or the rigid concrete roadside barrier.

Guidelines for the narrow median treatment are provided in section 630.

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## 620.10 GUIDELINES FOR REHABILITATION TYPE PROJECTS

### 1) Context

Highways that are constructed to meet recognized design criteria and follow the guidelines provided in section 620.06 for new construction and major reconstruction provide measurable advantages for the motoring public. However, available finances do not always permit the reconstruction or rehabilitation of existing highways to a higher level. These projects are often initiated for reasons other than geometric design deficiencies (e.g., pavement deterioration), and they often must be designed within restrictive right-of-way, financial limitations, and environmental constraints. As a result, the design criteria and guidelines for rehabilitation and reconstruction are often not attainable without major adverse impacts.

For these reasons, it may be applicable to adopt clear zone values on existing highways that are, in many cases, lower than the values for new construction or major reconstruction. The guidelines in this section are therefore intended to find the balance among many competing and conflicting objectives. These include supporting the objective of improving BC's existing highways, minimizing the impact of construction on existing highways, and improving the greatest number of highway kilometres within the available funds. The intent of these guidelines is to assist the implementation of cost-effective construction that may reduce the number and severity of run-off-the-road collisions, typically by identifying locations where the greatest safety benefit can be realized.

### 2) Application

Highway improvement projects fall into one of four types: new construction; reconstruction; resurfacing, restoration, rehabilitation, often referred to as 3R; and maintenance.

Guidelines for the first two types, new construction and reconstruction, are provided separately in section 620.06. The guidelines provided here in section 620.10 are most applicable to 3R type projects where, for reasons outlined in section 620.10 - 1), the guidelines for new construction/reconstruction are not cost-effective

3R projects involve rehabilitation, restoration and resurfacing and primarily work on an existing roadway surface and/or subsurface. The purpose

includes extending the service life of the roadway and enhancing the safety of the highway. To accomplish this objective, the focus should be on the most cost-effective safety improvements to improve safety where major reconstruction is not cost-effective.

### 3) Definitions

The following definitions apply to British Columbia 3R type projects:

**Rehabilitation** – The traffic service improvement and safety needs may be of equal importance to the need to improve the riding quality. Projects may involve intersection reconstruction, pavement widening, pavement replacement, shoulder widening, flattening foreslopes, drainage improvements and improvement of isolated grades, curves or sight distance by reconstruction. Some additional right-of-way may be necessary.

**Restoration** – This category is primarily for the major resurfacing or overlays of a nominal 100 mm or more which improve the strength and extend the life of the existing pavement. In addition, some pavement widening, short sections of pavement reconstruction, shoulder widening, flattening foreslopes on high fills and intersection reconstruction may be involved. Consideration may be given to improving isolated grades, curves, or sight distance by construction or traffic control measures. In some cases minor ROW acquisitions or easements may be required.

**Resurfacing** – Pavement resurfacing or overlays of less than a nominal 100 mm fall within this category. Other types of work such as pavement patching or short areas of reconstruction, joint replacement or repair, and shouldering may be included as part of the resurfacing project. Usually no additional right-of-way is required.

In general 3R improvements are made within the existing right-of-way and typically involve minimal changes to alignment or grade and no increase to capacity for the through lanes.

These guidelines are for 3R type projects as described above, and are intended to enhance roadway safety by helping to identify problem areas so that the adverse impact of run-off-the-road incidents can be reduced in a cost-effective way.

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These guidelines are not intended for projects where the purpose and scope is intended to replace or expand the facility, in which case guidelines for major reconstruction should be applied.

#### 4) General Guidance for Rehabilitation Type Projects

The guidelines for geometric improvements on existing highways are located in tab 13 of this manual. The following describes how to apply the “Corridor Ambient Geometric Design Element Guidelines” as defined in the context of clear zone principles.

The majority of existing highways were constructed before the application of clear zone as a standard. Accordingly, clear zone is not explicitly considered part of the ambient condition. The principal safety consideration in the ambient condition is the setback to utility poles and similar obstacles.

In terms of Ministry projects, recommended guidelines for pole locations are provided in Section 1120 of this manual. For open shoulder projects utilities should be located outside the clear zone, as per the appropriate design cross-section (and preferably within 2 m of the edge of the right-of-way) or protected by an approved barrier. However, section 1120.03 notes that the Ambient Guidelines policy replaces clear zone guidelines with Utility Setback language to ensure uniformity within the specific corridor under review.

On 3R projects, unless collision history, public complaint or site inspections indicate there is a safety problem, it may not be cost effective to fully comply with the typical clear zone requirements suggested for new construction/reconstruction. In addition, on many highways, the run-off-the-road collision rate may be too low to justify the cost of providing hazard free zones, as per section 620.06, throughout the length of the highway. Accordingly it may be appropriate to adopt clear zone values that are selective and generally “fit” conditions within the existing right-of-way and the character of the road.

For many projects, existing parallel slopes will generally remain the same, unless there is evidence of a problem at the site. This is in line with the application of the ambient conditions policy, outlined in tab 13, where the design principle is to maintain the ambient condition for the rehabilitation of a section of the corridor. Thus the elements of the rehabilitated section will essentially be the same as those of the ambient condition set for the corridor. Since most of the existing BC highways were constructed before the application of clear zone as a

standard, this may mean that in many cases the roadside design does not fully comply with typical clear zone requirements. If no operational or safety problems are identified, and the roadway has been performing well, this may be acceptable. However, where cost-effective improvements can be made to the roadside area, they should be considered. Where any variation from the ambient condition is justified (for example for reasons as noted in the policy document located in tab 13), consideration should be given to improving the roadside geometry where this is cost-effective. In addition, where the existing right-of-way permits significant slope flattening or where grading within the right-of-way is necessary, the designer should consider flattening parallel earth slopes, particularly on the outside of horizontal curves. Also, transverse slopes at driveways and accesses shall be re-graded and protected as described in chapter 700 of this manual.

Where it may not be cost-effective or feasible to comply fully with the clear zone distances suggested in Table 620.A, application of a “reduced” clear zone value for 3R type projects may be both prudent and appropriate. Section 620.10 -5) below provides some minimum clear zone guidance where the simple application of the ambient conditions utility setbacks alone may not be appropriate.

#### 5) Clear Zone Guidance

Where the application of the “full” clear zone requirements is not appropriate or cost-effective, a “reduced” clear zone application is proposed. In these cases, the designer may consider reducing clear zone distances from Table 620.A by as much as 40% with a minimum distance of 2 metres as per Table 620.C. These distances should be examined for the flattening of slopes and removal of obstructions. Where right-of-way is not restricted, front slopes should be 4:1 or flatter and back slopes 3:1 or flatter, but slopes may vary in relationship to prevailing conditions throughout the project and/or adjacent highway sections.

The designer should examine the possibilities to expand the roadway clear zone on the outside of relatively sharp horizontal curves to address the increased potential of vehicles running off the roadway at curves. Typically, this would normally be considered where collision histories indicate a need, or a site specific investigation shows a definite collision potential which could be significantly lessened by increasing the clear zone width, and such increases are cost-effective.

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**Table 620.C Suggested<sup>(¥)</sup> Minimum Design Clear Zone Distances in metres  
For Rehabilitation Type Projects on Rural Highways<sup>(¥¥)</sup>**

Design Year AADT	Minimum Clear Zone Width (m)				
	For Front Slopes 4:1 or flatter & Back Slopes 3:1 or flatter				
	Design Speed (km/h)				
	≤ 60	70 - 80	90	100	≥ 110
< 750	2.0	2.7	3.3	4.5	5.0
750 - 1500	2.7	3.5	4.5	6.0	6.5
1501 - 6000	3.0	4.5	5.5	7.0	8.0
> 6000	3.3	5.0	6.0	8.0	8.5

(¥) The designer may use lesser values than the suggested distances in this table only if these lesser values are justified using a cost-effectiveness analysis as outlined in section 620.07. The Design Clear Zone Inventory form in Figure 620.C must be filled-in by the designer and included in the design folder.

(¥¥) Rural highways are typically open ditch. Urban highways typically have curb and gutter with enclosed drainage.

- Notes:**
1. All distances are measured from the outer edge of the through traveled lane. Where a site specific investigation indicates a high probability of continuing crashes, or such occurrences are indicated by crash history, the designer may provide clear zone distances greater than the clear zone shown in Table 620.C.
  2. For clear zones, the "Design Year AADT" will be total AADT for both directions of travel for the design year. This applies to both divided and undivided highways.
  3. The values for "back slopes" only apply to a section where the toe of the slope is adjacent to the shoulder (enclosed drainage).
  4. The values in the table apply to tangent sections of highway. Refer to Figure 620.B for adjustment factors on horizontal curves.
  5. Refer to the TAC Geometric Design Guide for Canadian Roads for worked examples of calculations.

## 6) Roadside Hazards

In general, any obstructions within the suggested clear zone should be reviewed for removal, relocation, the use of breakaway supports, the provision of a barrier, or do nothing based on cost-effectiveness and safety considerations. This is especially relevant where "reduced" clear zone widths as described in previous section 5) are being considered. Reference should be made to the following section 7) for general guidance regarding various types of roadside hazards and specific considerations. Particular attention should be made to certain roadside hazards, such as poles, roadside barrier ends and trees, which are usually more threatening to vehicle occupants than others because of their positioning and structure, particularly in high speed environments. There is a general consensus that the minimum width for a clear zone to effectively reduce severe injury is 3 m.

Evaluation and selection of alternative treatments to mitigate hazardous roadside locations should be carried out using a cost-effectiveness methodology such as RSAP, discussed previously in section 620.07.

## 7) Identification of Problem Areas

Collision records, inspections of collision site, interviews with local officials involved in road safety such as local RCMP traffic detachment, Highway District Area Manager and citizen's safety committee and other sources of data can act as a useful guide in pinpointing areas within the project that have identifiable safety problems related to clear zone width and where available resources can be most effectively directed.

In terms of identifying high roadside collision locations, the designer should review the crash history for the last 3 to 5 years (e.g. HAS data) with respect to frequency, rate, location, type and severity in order to identify any probable safety deficiencies. Sources of available data include collision report forms (e.g. BC's MV 6020 Accident Report Form), BC collision databases (e.g. TAS and HAS), municipal collision databases, and ICBC claims data. However, the user needs to be aware of some of the problems and limitations of the data, including reduced reporting levels, inconsistent reduction in reporting levels, reliability of the data (especially for self reported incidents), accuracy of the collision data (at the scene/during data entry), timeliness of the collision data, and jurisdictional

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constraints. High roadside collision locations are considered to be those which exhibit higher potential for collisions than an established norm, for example where a collision frequency or rate exceeds a threshold value. A widely used statistical technique is to calculate a critical collision rate for the location, which represents a threshold value above which the occurrence of collisions may be attributed to site specific characteristics rather than random fluctuations in collision occurrence. Comparison of the calculated collision rate and the critical collision rate for similar facilities enables a "collision-prone" location to be identified. The HAS database itself can also be queried to identify collision prone locations and sections. The process of collision analysis is part of the procedural guidelines for determining ambient conditions under the BC policy, and enables safety or operational related problem areas to be identified.

In evaluating the collision history, the designer should look for possible concentrations of collisions that may justify construction of wider clear zones, similar to those required for new construction/reconstruction, over a short section of the project. If only a few isolated hazards exist within the desirable clear zone and if these hazards can be removed or relocated at a low cost, the plan should provide for removal or relocation. Normally, acquisition of right of way just to obtain the desirable clear zone is not cost effective.

## 620.11 WORKED EXAMPLES

In the application of the clear zone concept for British Columbia, the TAC Geometric Design Guide's method used for Roadside Channels is not required. For examples of clear zone calculation, refer to the TAC Geometric Design Guide and the AASHTO Roadside Design Guide.

## 620.12 DESIGN CRITERIA SHEETS FOR CLEAR ZONE TREATMENT

**Figure 620.B Design Clear Zone Inventory – New Construction & Reconstruction**

**Note: This sheet must be completed for all sections of the design project including those locations where clear zone is met.**

[illegible]

- (1) Distances meet or exceed suggested guidelines in Tables 620.A & B.
- (2) Include references to appropriate documents in the design folder that contain detailed analyses and calculations.

**Note: This sheet must be completed for all sections of the design project including those locations where clear zone is met.**

Locations where clear zone distances as per Tables 620.B & C are met. Indicate the achieved recovery zone distances.(3)

- (3) Include references to appropriate documents in the design folder that contain detailed analyses and calculations.

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## 620.13 ROADSIDE SAFETY IN AN URBAN ENVIRONMENT

For the purpose of this section an urban highway section must be posted at 60 km/h or less and is defined as having at least one of the following traffic environments:

- Reduced speed zone in the vicinity of a residential or commercial subdivision;
- Highway section with curb-and-gutter or a sidewalk;
- The average spacing is less than 150 metres for driveways and 500 metres for intersections.

The Clear Zone in an urban environment with restricted right-of-way is:

- 4.0 m from the edge of the traveled lane in open ditch situations;
- The greater of the following clearances: 2.0 from the face of the curb in closed drainage situations or 0.3 m beyond the sidewalk.

The Clear Zone in an urban environment where right-of-way is not restricted is to be evaluated similar to a suburban or transition area as described below.

Sections of highway that are posted at 70 km/h are typically in suburban or transition areas. In these cases, the designer should do a risk review considering local traffic conditions before deciding to apply the rural or urban clear zone guidelines. In these cases, the designer should consider guidelines that are contained in the AASHTO Roadside Design Guide, 3<sup>rd</sup> Edition 2006, chapter 10 – Roadside Safety in Urban or Restricted Environments.

## 620.14 REFERENCES

### References used specifically for this chapter:

The following reports commissioned by BC MoT were used to produce chapter 600 – Safety Elements:

- CH2MHILL, Review of Roadside Hazard Mitigation Practices used by North American Road Agencies and Professional Transportation Organisations. May, 2005

### General References:

- AASHTO, Roadside Design Guide, 3<sup>rd</sup> Edition, 2006.
- Transportation Association of Canada, Geometric Design Guide for Canadian Roads, 1999 Edition.
- Transportation Association of Canada, Canadian Guide to 3R/4R. August 2001.



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## 630 MEDIAN TREATMENT

### 630.01 GENERAL

The primary use of median separation is to eliminate the risk of head-on collisions and to control access.

The standard median treatments are:

- no median separation (undivided road)
- narrow flush median with or without barrier
- depressed median with traversable slopes

### 630.02 GUIDELINES

Use the following guidelines and Figure 630.B when selecting a median treatment:

1. Median Barrier is not normally used and a median separation is optional on low speed multilane highways (posted speed less than 70 km/h).
2. For 4-lane rural arterials with less than 10,000 AADT<sup>1</sup>, median barrier is not required unless indicated by accident history.
3. For 4-lane rural arterials with between 10,000 and 20,000 AADT<sup>1</sup>, median barrier is not required unless indicated by accident history. However, the 2.6 m median without barrier should be used as a staged development, anticipating the future placement of barrier.

4. For rural arterials with 20,000 AADT<sup>1</sup> or greater, either the median barrier with narrow flush median, or the 13 metre wide depressed median should be used.
5. When barrier is to be installed on an existing facility which has less than the standard 2.6 m median, widening to 2.6 m is required to provide one metre of shy distance from the lane edge to the barrier.

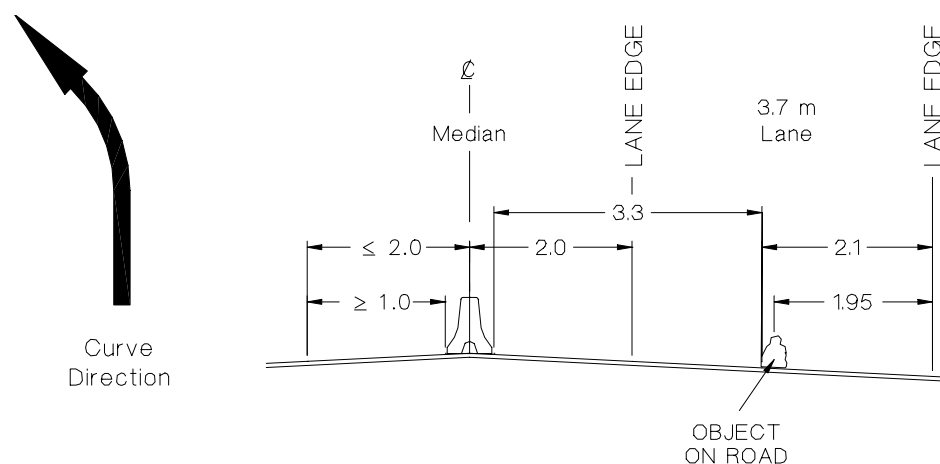
However, installation of median barrier on narrower medians may be approved by the Senior Highway Safety Engineer in special circumstances if safety, geometry, maintenance, and costs are adequately addressed.

6. Where sight distance may be restricted by tight curvature in conjunction with median barrier, the preferred treatment is to flatten the curves or use depressed median. However, these treatments may not be cost-effective when constructing in built up or mountainous areas.

A modified median has been chosen to provide some additional sight distance and allow the driver some extra width to swerve safely around an object that partially obstructs the inside lane. See Figure 630.A.

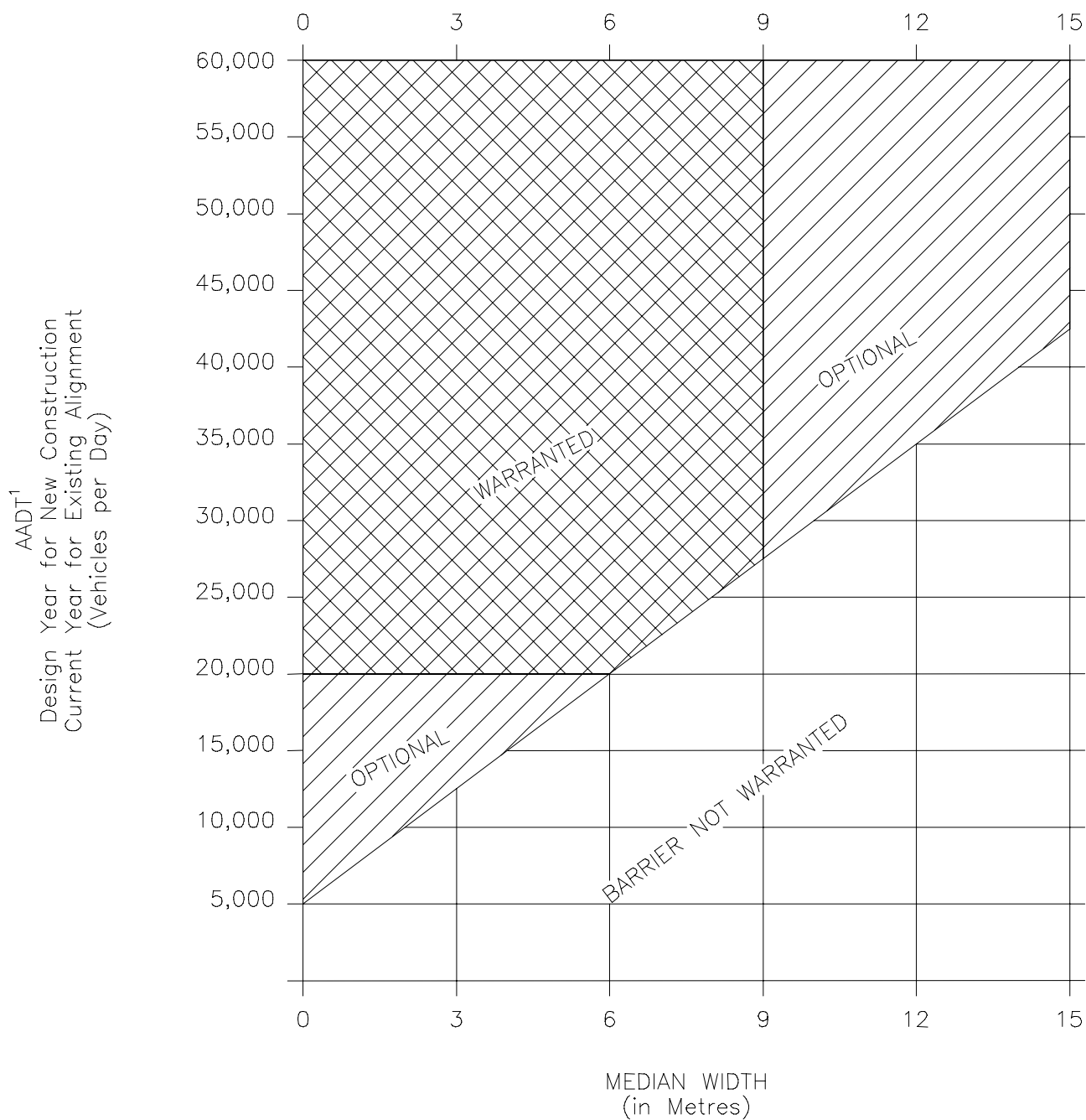
The modified treatment has a symmetrical 4 m median separation; in very tight situations, you may consider leaving the median on the side without sight restriction with 1.3 m separation from the centerline.

**Fig. 630.A Modified Median**



<sup>1</sup> Contact Regional or Headquarters Planning for the SADT to AADT conversion factors for your projects.

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**Fig 630.B Guidelines for Median Barrier Placement**

<sup>1</sup> Contact Regional or Headquarters Planning for the SADT to AADT conversion factors for your projects.

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## 640 HIGHWAY SAFETY DRAWINGS

### 640.01 Dimensions of Roadside Barrier Approach and Opposing Flares on Rural Highways

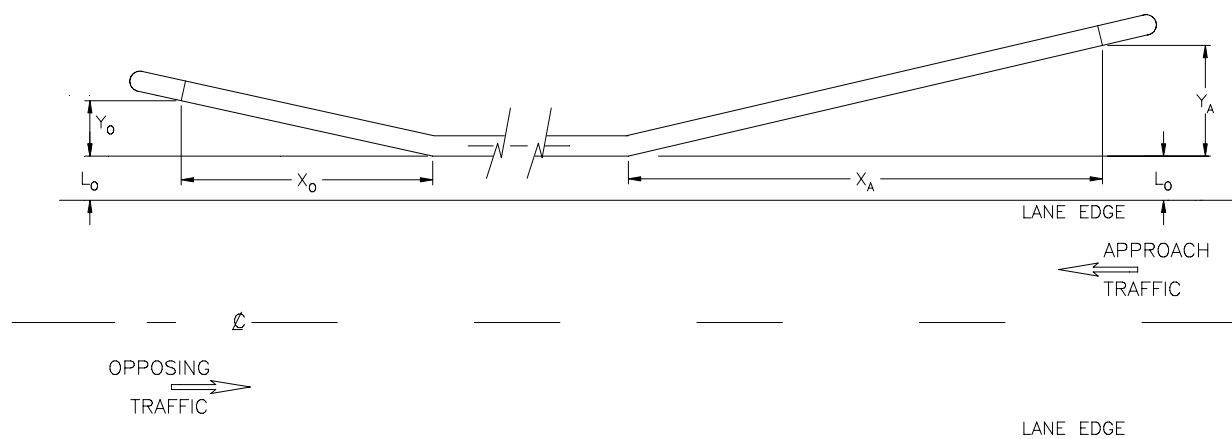
Several old drawings continue to be included from the Highway Safety Engineering (HSE) Section. This section gives the dimensions of roadside barrier approach and opposing flares that are applied to the HSE drawings.

Until they have been reviewed and revised, some of the old HSE drawings are provided in the original format and content.

In most drawings, only the headers and footers have been changed. Where the drawings were converted from manual to CAD drawings, some graphic re-arranging has occurred, as well as some additions to the tables for speeds of 110 km/h.

Where no CAD conversion has been done, the drawings have been scanned and inserted into the document.

**Figure 640.A Roadside Barrier Approach and Opposing Flares**



**$L_0$  = Normal Paved Shoulder without Barrier; minimum width = 1.3 m (except on LVR)**

The offset  $Y_A$  is dependent of the speed and volume; the length of need  $X_A$  is speed dependent only. (Refer to Tables 640.A and 640.B for  $Y_A$  and  $X_A$  dimensions.)

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**Table 640.A Barrier Approach Flare Dimensions on Rural Highways  
For New Construction and Major Reconstruction Projects**

Barrier Approach Flare															
Longitudinal dimension X <sub>A</sub> & Lateral offset Y <sub>A</sub> (metres)															
		Design Speed (km/h)													
Design ADT	Assumed L <sub>0</sub> <sup>1</sup>	<60		60		70		80		90		100		110	
		X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>
≤ 200	0.0 <sup>3</sup>	See Note 3		See Note 3		See Note 3		See Note 3		See Note 3		See Note 3		See Note 3	
201 - 750	1.3 <sup>2</sup>	27.5	1.7	34.9	1.7	42.4	2.2	47.4	2.2	52.4	3.2	59.9	3.4	67.4	3.4
751 - 1500	1.5 <sup>2</sup>	27.5	2.0	34.9	2.0	42.4	3.3	47.4	3.4	52.4	3.4	59.9	3.4	67.4	3.4
1501 - 6000	2.0 <sup>2</sup>	27.5	2.5	34.9	2.5	42.4	3.3	47.4	3.4	52.4	3.4	59.9	3.4	67.4	3.4
> 6000	2.5 <sup>2</sup>	27.5	2.5	34.9	2.5	42.4	3.3	47.4	3.4	52.4	3.4	59.9	3.4	67.4	3.4
No. of CRB Units		11		14		17		19		21		24		27	

## Notes:

1.  $L_0$  = Normal Paved Shoulder width without safety barrier.
2. These are the assumed distances between parallel barrier sections and the edge of the travel lane. If the actual  $L_0$  is less than the table value, the " $Y_A$ " must be increased so that the total  $L_0 + Y_A$  are the same as in the table. In all cases,  $L_0$  must not be less than 1.3 metres. Correspondingly, if the  $L_0$  happens to be greater than that listed in the table, the value of " $Y_A$ " is decreased by the same amount.
3. Refer to Section 510.09 of the Low-volume Roads chapter.
4. When the shoulder is less than 1.3 m, the width of shoulder shall be increased so that the offset to the face of the parallel length of barrier is at least 1.3 m for all highways with an ADT  $> 200$ . The  $Y_A$  is measured from the face of the parallel length of barrier, not the lane edge line. Refer to Figure 640.A. For example, on an 80 km/h design with 2.0 m shoulders and a design ADT of 3,500, the shoulder is widened over the length of the barrier so that the offset to the barrier is still 2.0 m; the  $Y_A$  is added to the 2.0 m to provide 5.4 m of width between the lane line and the standard terminal section on the end of the approach flare.
5. Above and to the left of the heavy line, the  $L_0 + Y_A$  value is equal to the higher value for Clear Zone distance listed in Table 620.A for front slopes 6:1 or flatter.
6. Below and to the right of the heavy line, the  $Y_A$  is based on the flare rates (which are speed dependent) shown in the AASHTO Roadside Design Guide. Clear Zone has no bearing on these  $Y_A$  distances.
7. Number of CRB units shown in the table may be increased but never reduced.

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**Table 640.B Barrier Approach Flare Dimensions on Rural Highways  
For Rehabilitation Projects**

Barrier Approach Flare															
Longitudinal dimension X <sub>A</sub> & Lateral offset Y <sub>A</sub> (metres)															
		Design Speed (km/h)													
Design ADT	Assumed L <sub>0</sub> <sup>1</sup>	<60		60		70		80		90		100		110	
		X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>	X <sub>A</sub>	Y <sub>A</sub>
≤ 200	0.0 <sup>3</sup>	See Note 3		See Note 3		See Note 3		See Note 3		See Note 3		See Note 3		See Note 3	
201 - 750	1.3 <sup>2</sup>	27.5	0.8	34.9	0.8	42.4	1.4	47.4	1.4	52.4	2.0	59.9	3.2	67.4	3.4
751 - 1500	1.5 <sup>2</sup>	27.5	1.2	34.9	1.2	42.4	2.0	47.4	2.0	52.4	3.0	59.9	3.4	67.4	3.4
1501 - 6000	2.0 <sup>2</sup>	27.5	1.2	34.9	1.2	42.4	2.5	47.4	2.5	52.4	3.4	59.9	3.4	67.4	3.4
> 6000	2.5 <sup>2</sup>	27.5	1.2	34.9	1.2	42.4	2.5	47.4	2.5	52.4	3.4	59.9	3.4	67.4	3.4
No. of CRB Units		11		14		17		19		21		24		27	

## Notes:

1.  $L_0$  = Normal Paved Shoulder width without safety barrier.
2. These are the assumed distances between parallel barrier sections and the edge of the travel lane. If the actual  $L_0$  is less than the table value, the " $Y_A$ " must be increased so that the total  $L_0 + Y_A$  are the same as in the table. In all cases,  $L_0$  must not be less than 1.3 metres. Correspondingly, if the  $L_0$  happens to be greater than that listed in the table, the value of " $Y_A$ " is decreased by the same amount.
3. Refer to Section 510.09 of the Low-volume Roads chapter.
4. When the shoulder is less than 1.3 m, the width of shoulder shall be increased so that the offset to the face of the parallel length of barrier is at least 1.3 m for all highways with an ADT  $> 200$ . The  $Y_A$  is measured from the face of the parallel length of barrier, not the lane edge line. Refer to Figure 640.A. For example, on an 80 km/h design with 2.0 m shoulders and a design ADT of 3,500, the shoulder is widened over the length of the barrier so that the offset to the barrier is still 2.0 m; the  $Y_A$  is added to the 2.0 m to provide 5.4 m of width between the lane line and the standard terminal section on the end of the approach flare.
5. Above and to the left of the heavy line, the  $L_0 + Y_A$  value is generally based on the Clear Zone distance listed in Table 620.B.
6. Below and to the right of the heavy line, the  $Y_A$  is based on the flare rates (which are speed dependent) shown in the AASHTO Roadside Design Guide. Clear Zone has no bearing on these  $Y_A$  distances.
7. Number of CRB units shown in the table may be increased but never reduced.

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## 640.02 Opposing Flare

### 640.02.01 For Highways with $ADT \leq 200$

Because of the narrowness of Low-volume Roads that have an  $ADT \leq 200$ , there is no difference in the design of approach and opposing flares. Although Clear Zone is not a design parameter for Low-volume roads, good safety practice requires consideration of dimensions for barrier offsets. As there is no minimum 1.3 m offset to the face of barrier for these roads, the flare requirements as shown in Table 510.M of the Low-volume Roads Interim Guidelines are recommended.

### 640.02.02 For Highways with $ADT > 200$

The offset, from the centreline of the roadway, for the opposing guardrail end, must be equal to or greater than that of the approach end offset, as measured from the lane edge (see Figure 640.B). The minimum offset of the opposing end from the near lane edge, for two lane highways, without auxiliary lanes shall be 1.3 m or the normal paved shoulder, whichever is greater. The minimum for two lane highways with truck lanes shall be 1.3 m. The minimum for four lane undivided highways without auxiliary lanes shall be 1.3 m or the normal paved shoulder, whichever is greater. The minimum for 4-lane

highways with auxiliary lanes shall be 1.0 m. All offsets are measured from the lane edge marking to the toe of the barrier.

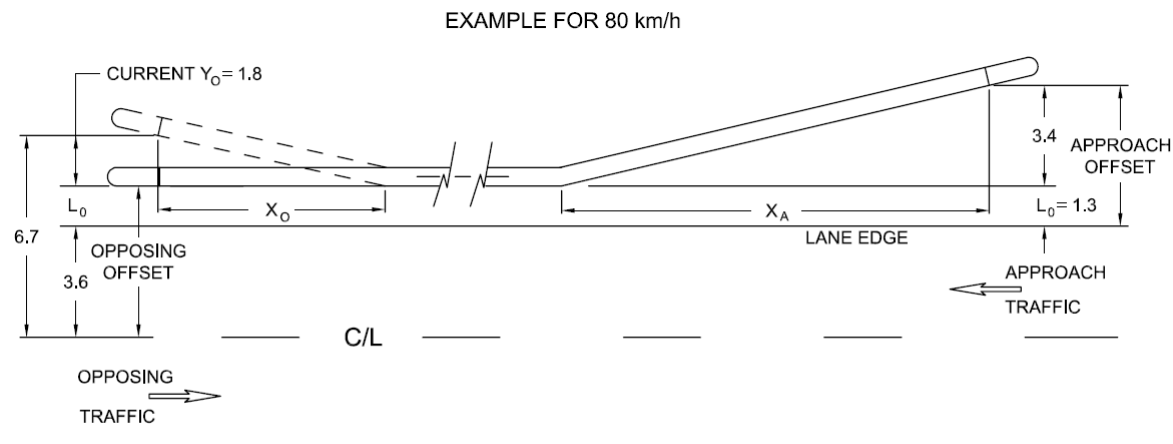
### 640.02.03 Caveat

The previous procedure of using opposing flares for all 2-lane highways represented a standard that needed no further consideration for the likelihood of passing vehicles encroaching on the opposing direction flare. While the new treatment provides construction savings, its use needs to be tempered by the provision of passing opportunities. The designer needs to review for the potential of passing occurring in the vicinity of the reduced or eliminated opposing flare.

Because of exposure of opposing traffic to the end treatment, when passing on a 2-lane highway, care should be taken to ensure that either normal opposing flares are used or that the barrier is extended to a location on the inside of a curve or into a no passing zone.

If the barrier would normally end on the outside of a curve, the length of barrier should be extended through the curve and ended on tangent or on the inside of a curve.

**Figure 640.B Roadside Barrier with No Opposing Flare**

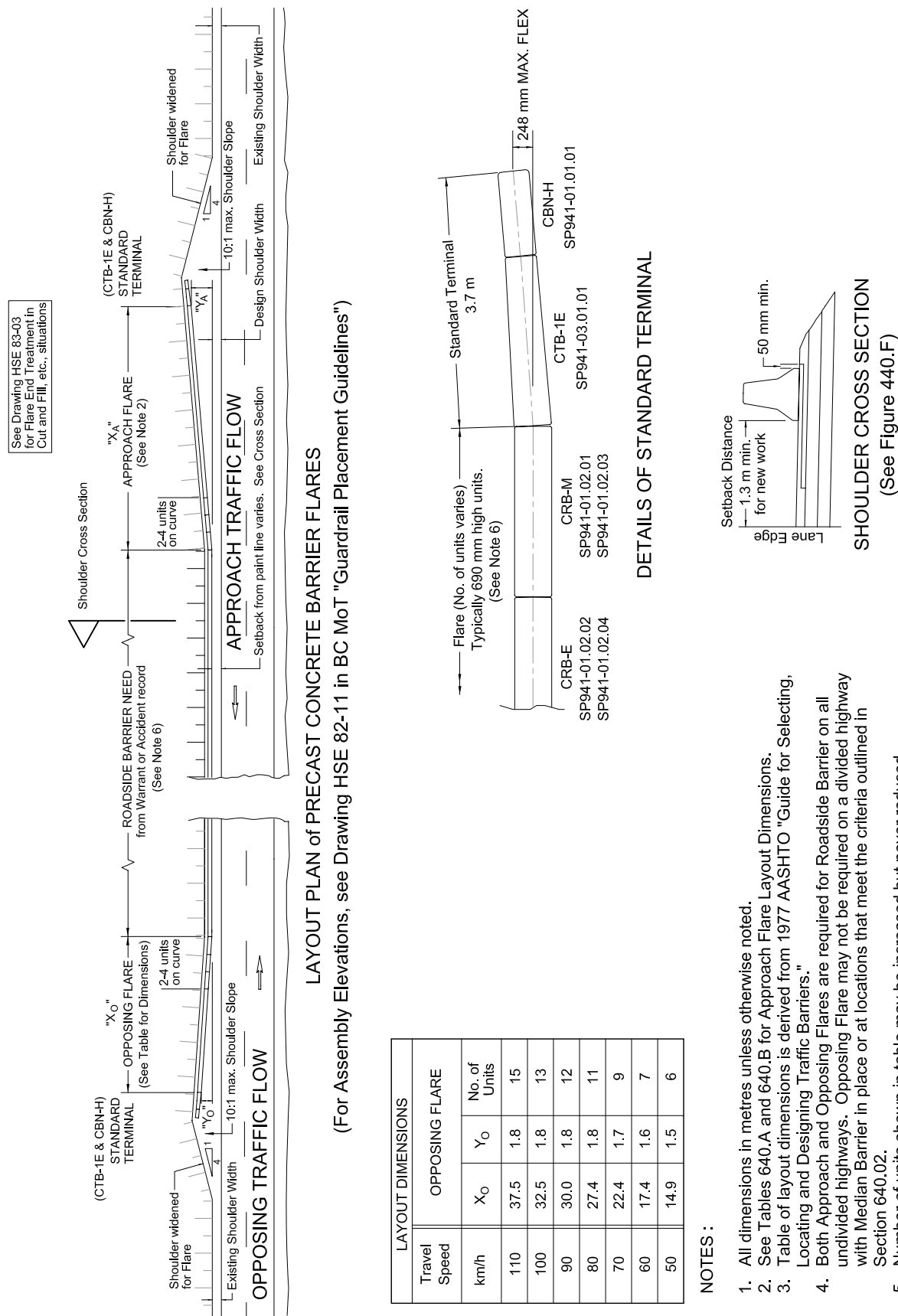


$L_O$  = Normal Paved Shoulder without barrier; minimum width = 1.3 m

Although  $Y_O$  is reduced, the length of need  $X_O$  is speed dependent and not to be reduced

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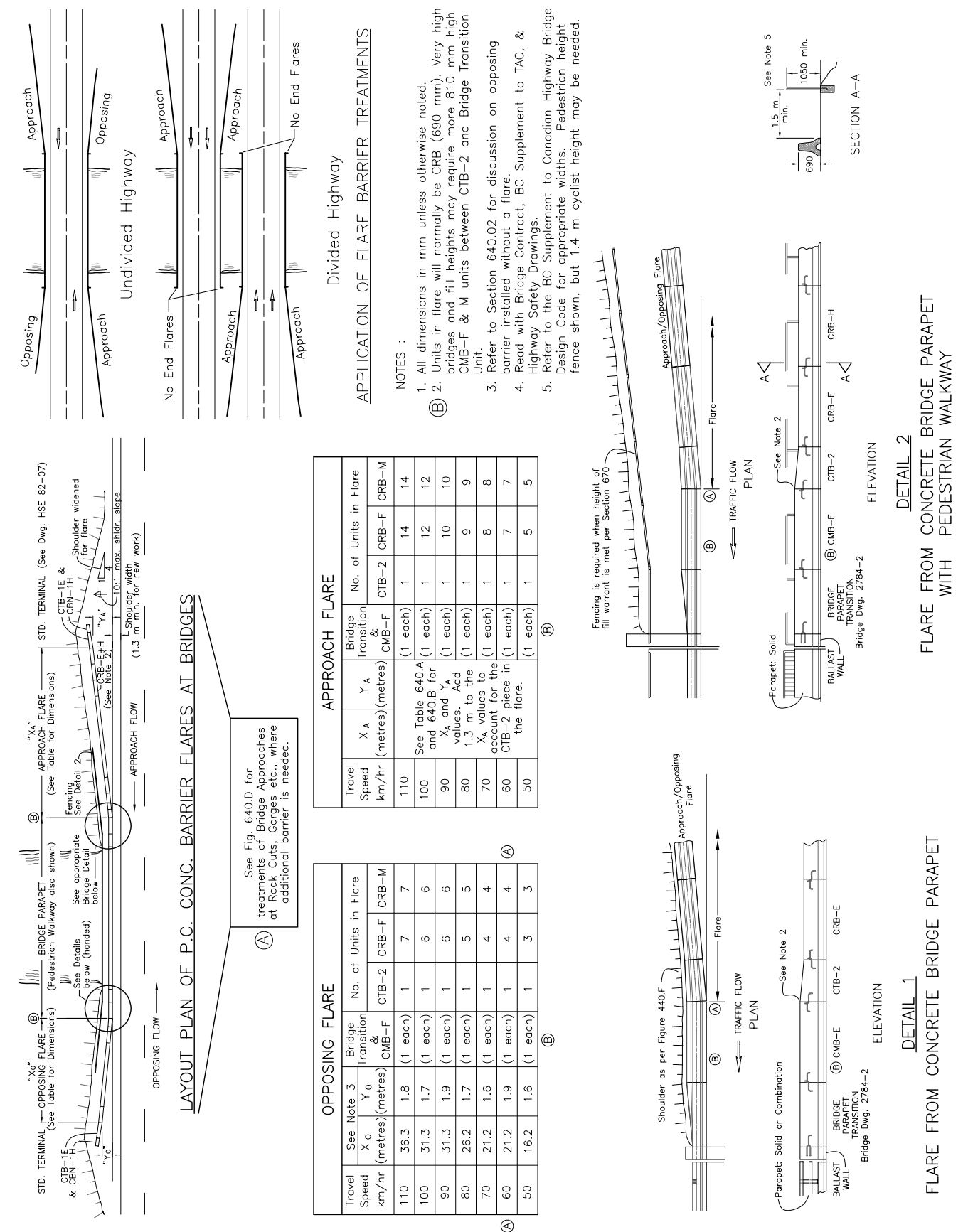
**Figure 640.C Standard Layout of Flares and Terminals for Concrete Roadside Barriers**  
N.T.S. (old HSE 82-07A)





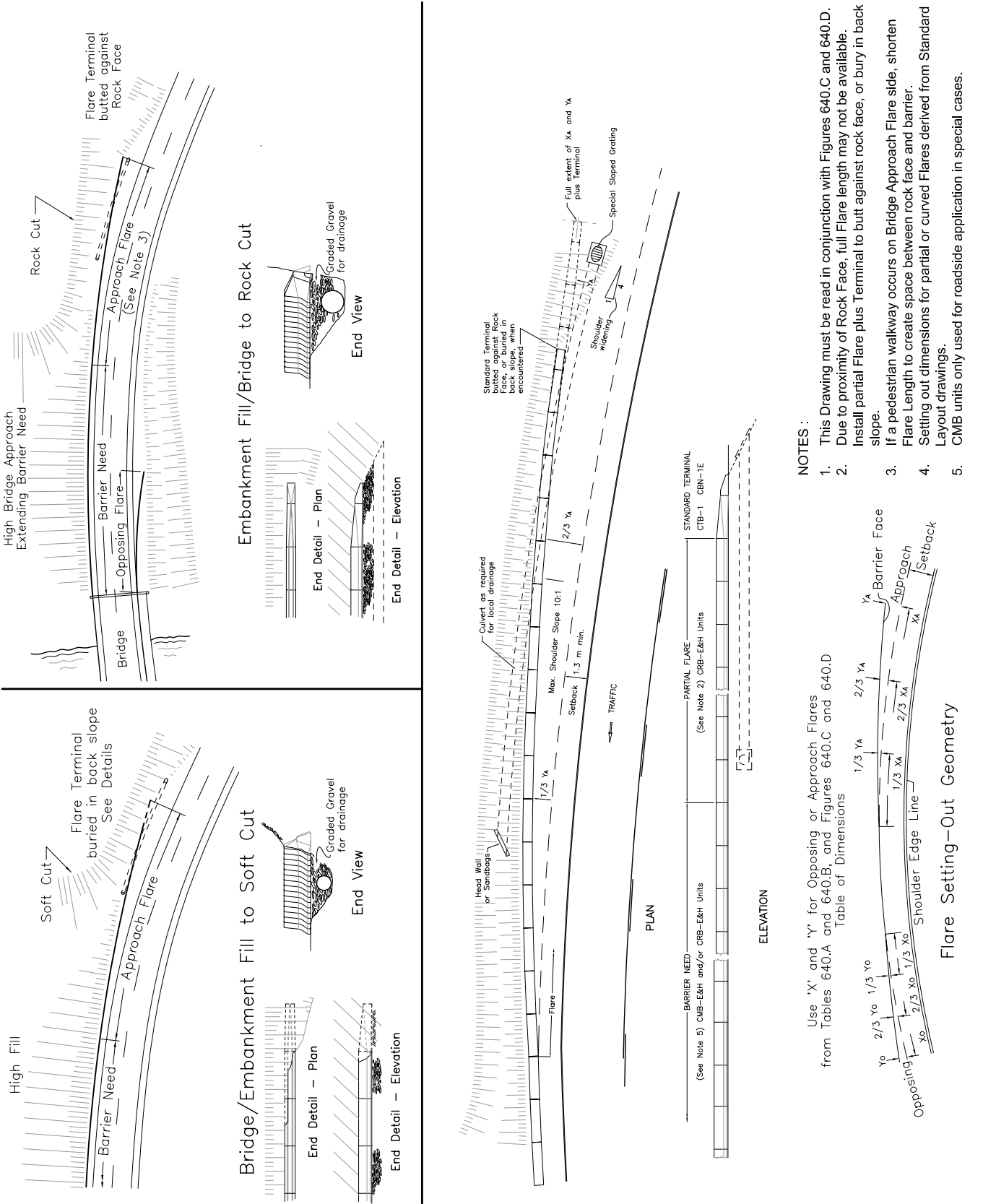
MoT Section	640	TAC Section	Chapter 3.2
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Figure 640.D Standard Layout of Flares for Concrete Roadside Barriers at Bridge Ends  
N.T.S. (old HSE 83-01B)



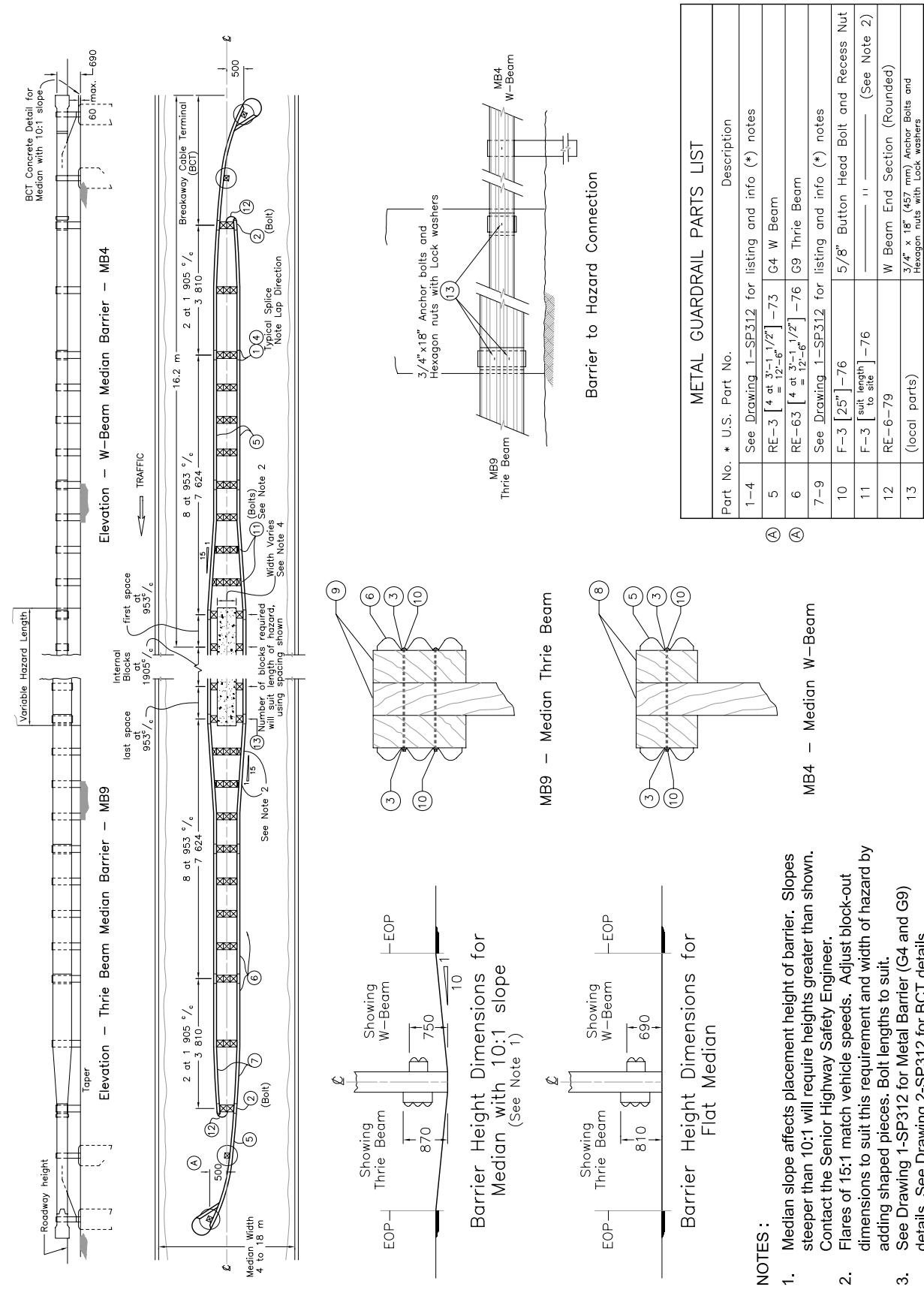
MoT Section	640	TAC Section	Chapter 3.2
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**Figure 640.E Roadside Barrier Layouts at Cut & Fill, and Curves**  
N.T.S. (old HSE 83-03)



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Figure 640.F MB4/MB9 Median Hazard Treatment in 4-18 m Undepressed Medians  
N.T.S. (old HSE 83-13A)





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## 650 RUMBLE STRIPS

### 650.01 Shoulder Rumble Strips

#### Considerations

Shoulder Rumble Strips (SRS) should be considered on rural highways in the following cases:

1. New rural highway sections;
2. When re-paving, rehabilitating or reconstructing existing rural highway sections, which include the shoulders;
3. Other rural Highway Sections that are not part of a project but that would benefit from the installation of SRS in terms of decreasing the number of single vehicle off-road crashes. To assist Ministry Regions, a prioritized list of highway sections is available from Engineering Branch, which identifies possible candidate locations; however it does not limit SRS to only those locations. Funding and other resources for these stand-alone SRS projects are subject to availability and should be considered in the larger context of all safety initiatives.

SRS should not be used in urban areas. Good indications of urban highway sections are:

1. Speed Zone of 70 km/h or less in the vicinity of a settlement;
2. Highway section with curb and gutter or a sidewalk;
3. The average driveway spacing is less than 150 metres and intersection spacing is less than 500 metres.

The minimum shoulder depth of pavement required is 50 mm. SRS are not to be installed if pavement deterioration or cracking is evident. (NOTE: There is no concern with the outer edges of the SRS and the first lift of asphalt being at the same vertical location.)

All projects that involve SRS should be submitted for ICBC Cost-Sharing evaluation.

#### Application Guidelines

The Layout for Milled-in SRS is shown in Figure 650.A.

SRS should be installed on shoulders, in both directions, for rural two lane and four lane undivided highways.

On rural four lane divided arterials, expressways and freeways (RAD, RED & RFD), the SRS should be installed on both the outside and the median shoulders.

SRS should be installed, in both directions, on the median of rural highways with painted flush medians that are at least 2.0 m wide. This includes locations with existing median barrier if there is sufficient room for the milling machine to install the SRS. For widths less than 2.0 m, refer to Section 650.03 - Centreline Rumble Strips.

Shoulders that are to have SRS installed should be a minimum of 0.5 m wide where there is no cycling traffic on the shoulder. Shoulders with SRS that have cycling traffic should be at least 1.5 metres wide.

#### Alternatives to SRS

Should other audible delineation devices be approved, the use of such approved devices, which minimize the reduction of usable smooth paved shoulder, should be considered on the same cost-effective basis as SRS.

#### SRS Installation

Figure 650.A shows the Patterned SRS installation for outside shoulder locations. Discussion with cycling advocates suggests that regular gaps should be provided to facilitate movement to/from the shoulder. The patterned SRS should be installed in a repeating cycle consisting of approximately 15 m of rumble strips followed by approximately 3.5 m of gap.

MoT Section	650		TAC Section	2.2.4.3
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Figure 650.A shows the Continuous SRS installation for median shoulder locations and painted flush medians.

### **SRS Interruptions**

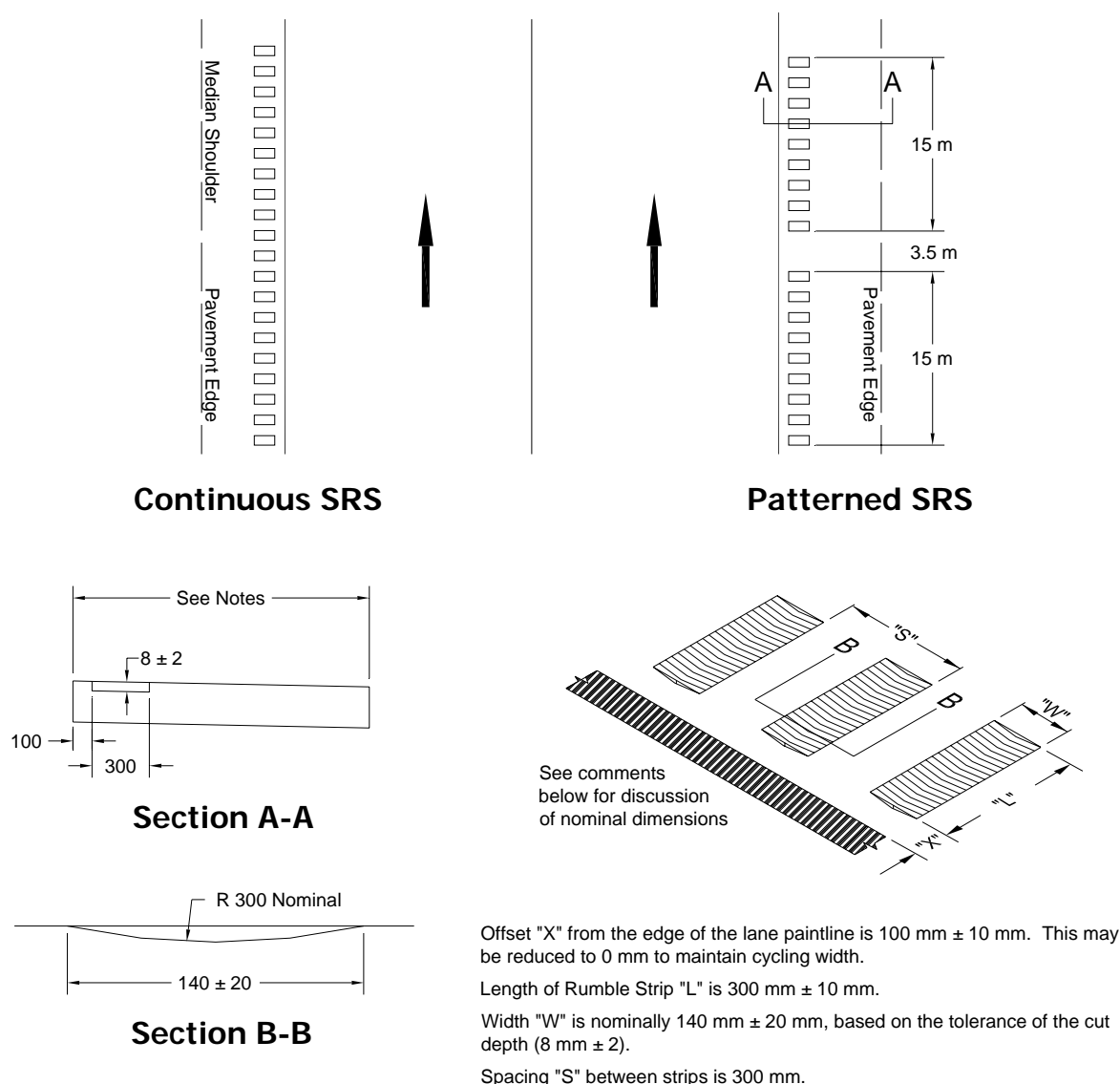
SRS are to be interrupted prior to driveways, intersections, ramps, shoulder constraints and wherever it is needed and required to allow cyclists to merge to the left of the SRS, as shown in Figures 650.B, 650.C and 650.D.

Shoulder rumble strips shall not be installed on bridge decks, overpasses or other concrete surface structures.

### **Paint Marking for SRS**

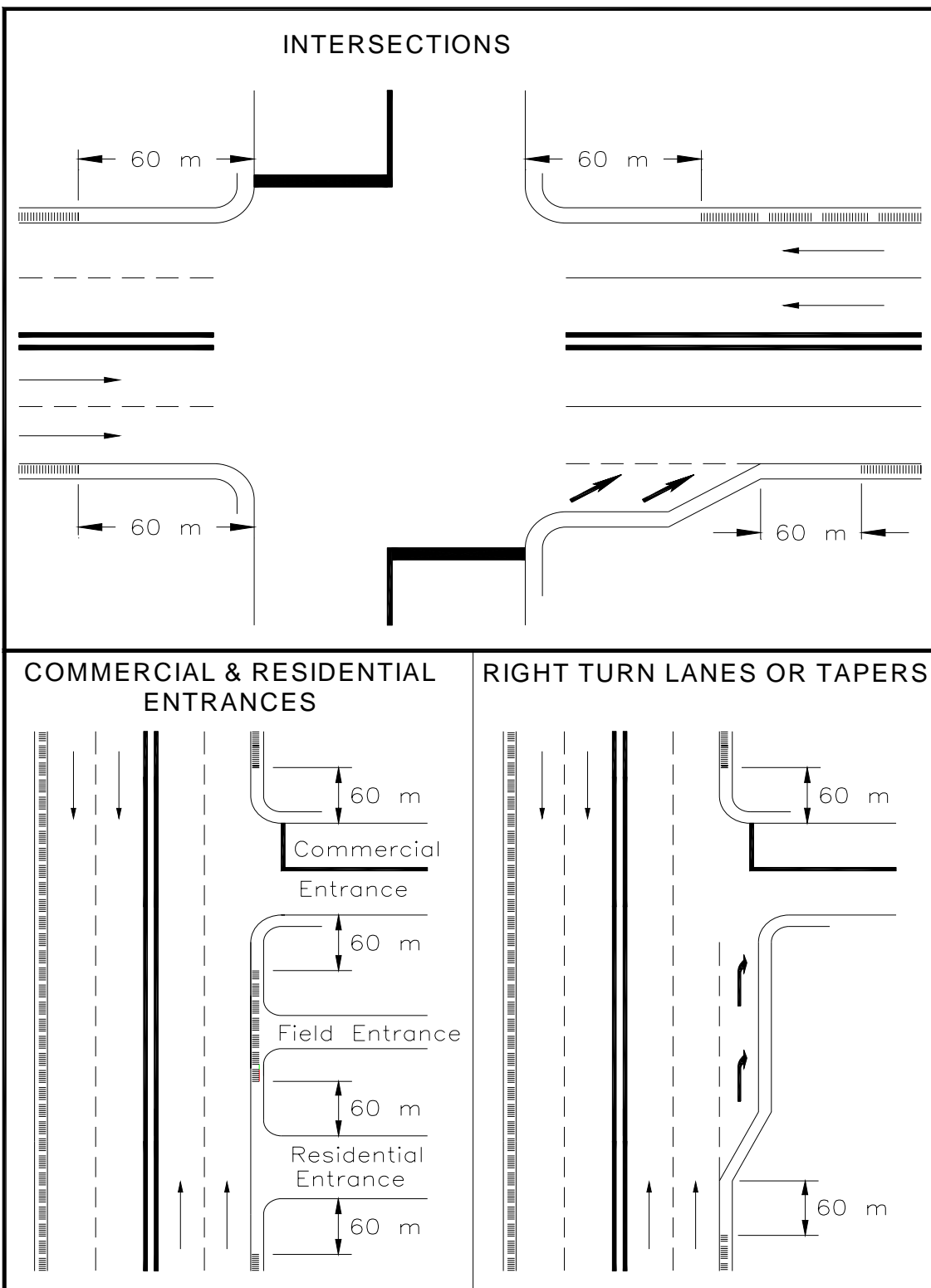
To inform cyclists of the beginning of SRS, three white lines shall be painted approximately 5.0 m in front of the first milled rumble strip, as shown in Figure 650.E.

MoT Section	650	TAC Section	2.2.4.3
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**Figure 650.A Milled Shoulder Rumble Strips****NOTES:**

- Milled-in SRS are to be placed on existing/new paved shoulders on:
  - 2-Lane highways with minimum 1.5 m shoulders
  - Multi-Lane undivided highways with minimum 1.5 m shoulders
  - Multi-Lane divided highways with minimum 0.8 m shoulders inside and 1.5 m outside.
- The minimum shoulder depth of pavement required is 50 mm. SRS are not to be installed if pavement deterioration or cracking is evident.
- Milled-in SRS are to be placed on existing/new paved centre medians with a minimum 2.0 m painted width. This includes locations with existing median barrier if there is sufficient room for the milling machine to install the SRS. For widths less than 2.0 m, see Figure 650.F.
- Patterned SRS installation is for outside shoulder locations. Continuous SRS installation is for median shoulder locations and painted flush medians.
- Milled-in SRS may be placed where outside shoulders are less than 1.5 m if there is no cycling traffic on the shoulder.
- Milled-in SRS are not to be placed through urban areas or in the presence of turning lanes.
- Milled-in SRS are to be discontinued across private accesses and public road intersections. Refer to Figures 650.B and 650.C.
- Milled-in SRS are to be discontinued in advance of all bridges and where minimum dimensions do not exist because of Roadside Barrier, Drainage Curb, Fencing, Rock Face, etc. Refer to Figure 650.D.
- Shoulder rumble strips shall not be installed on bridge decks, overpass structures, or other concrete surfaced structures.

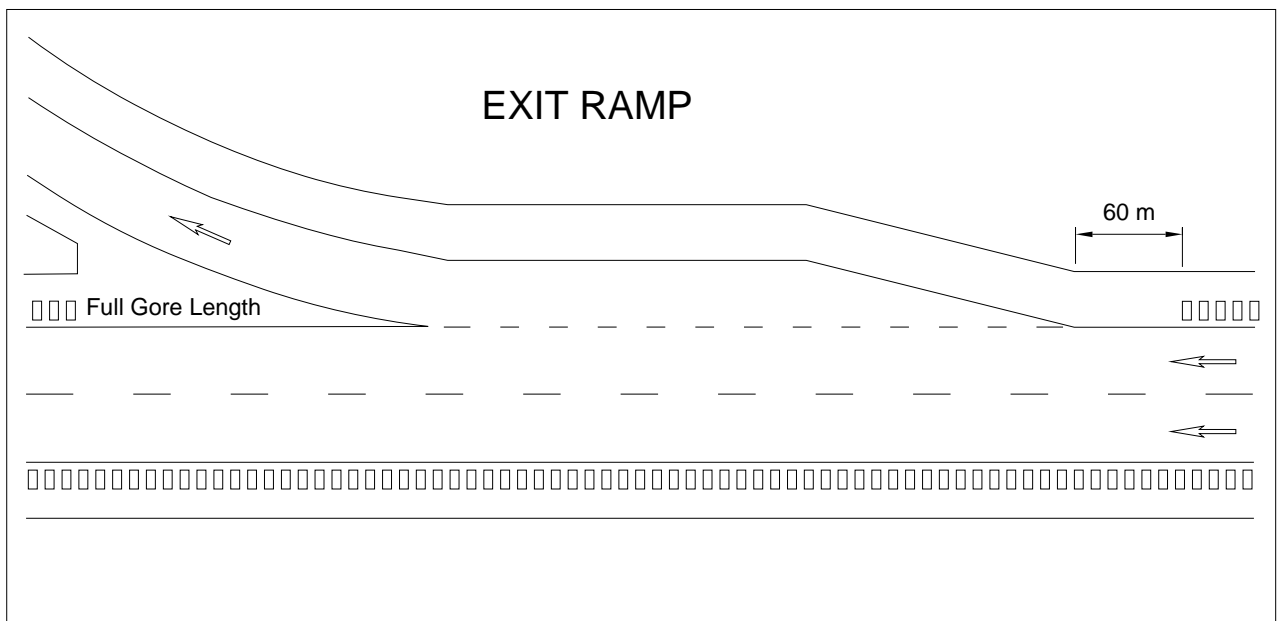
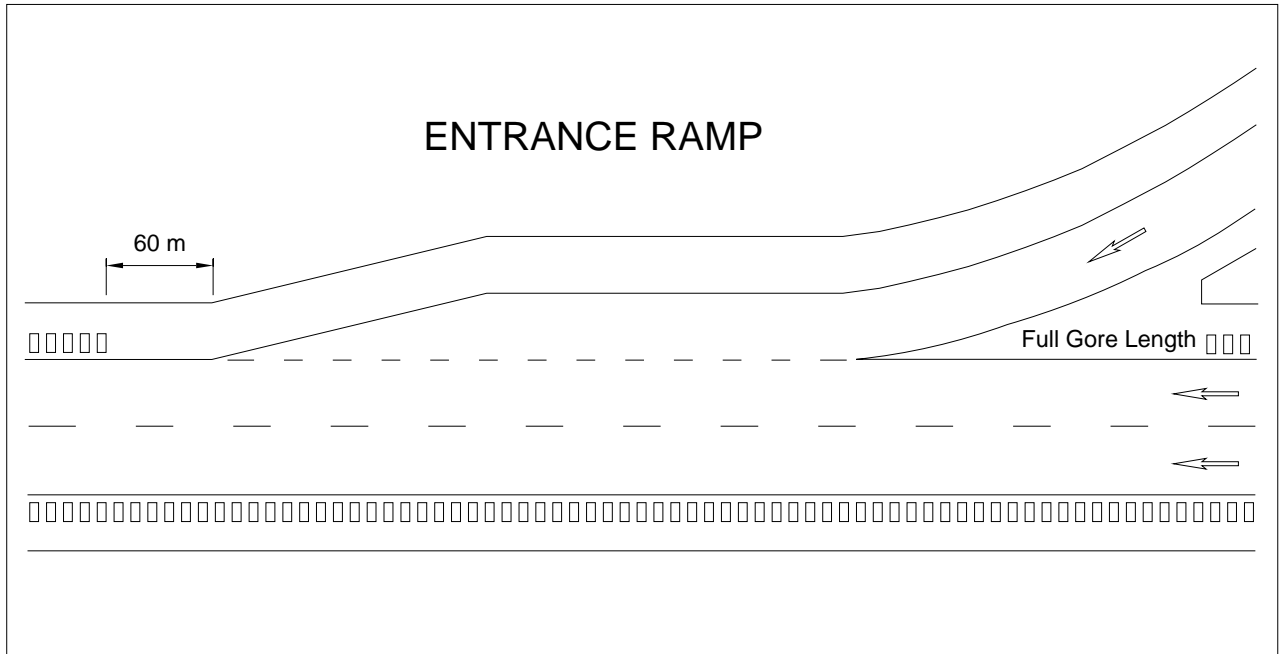
MoT Section	650	TAC Section	2.2.4.3
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**Figure 650.B SRS Interruptions at Intersections and Driveways**

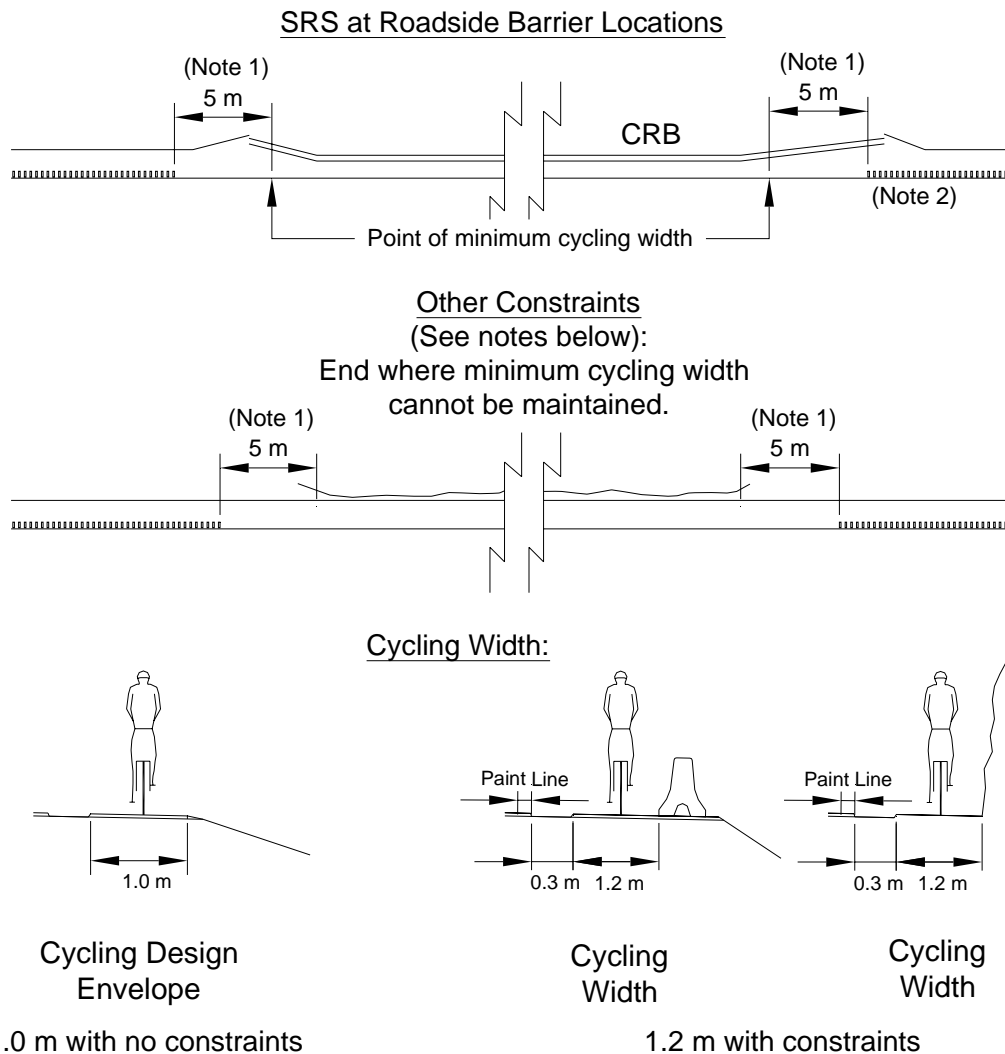


MoT Section	650		TAC Section	2.2.4.3
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**Figure 650.C SRS Interruptions at Exit and Entrance Ramps**



MoT Section	650	TAC Section	2.2.4.3
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**Figure 650.D SRS Interruptions at Shoulder Constraints****NOTES:**

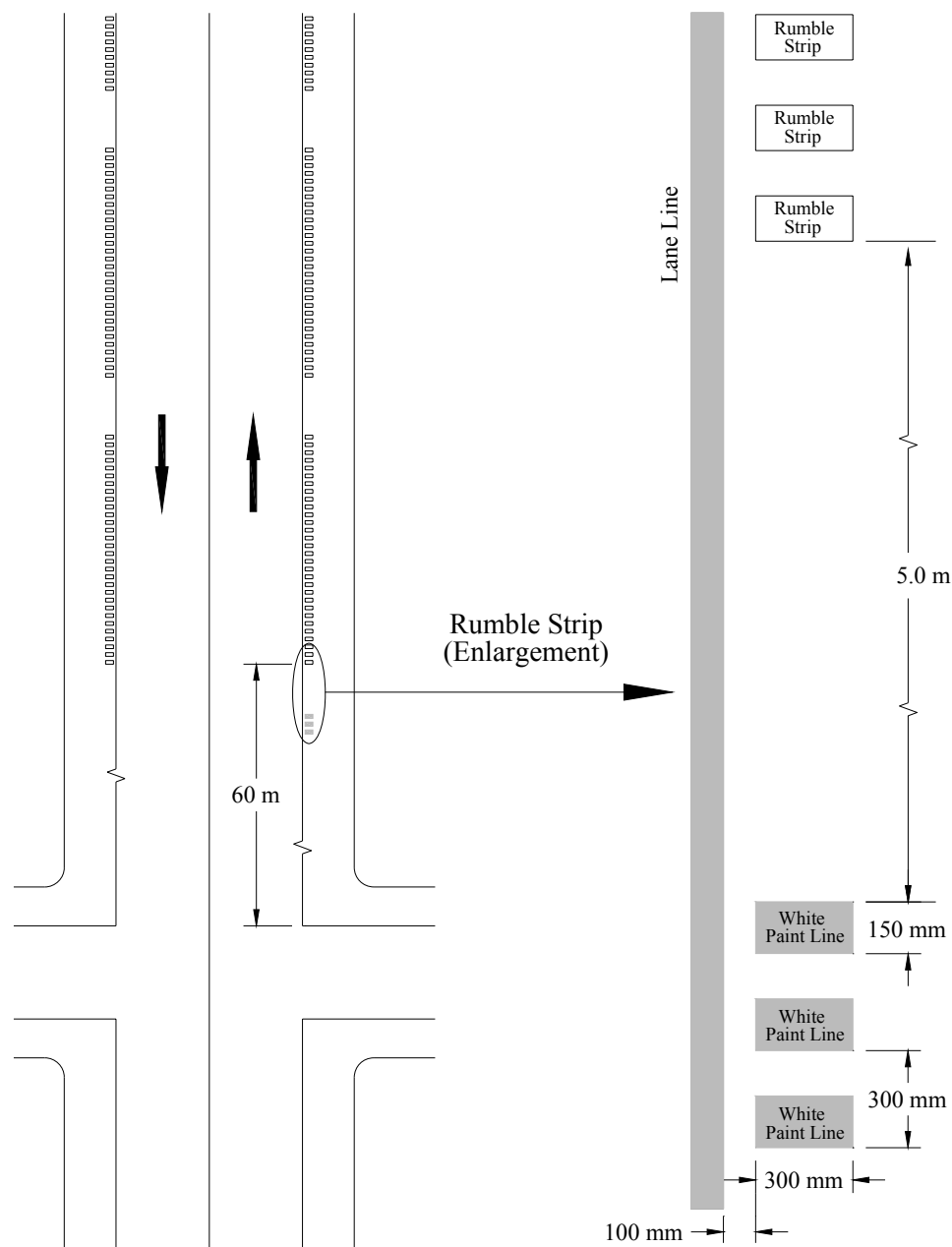
1. The minimum acceptable cycling width with a longitudinal obstruction is 1.2 m. The SRS should be discontinued 5 m before and restarted 5 m after where this width to longitudinal constraints cannot be maintained.
2. If there is adequate cycling width adjacent to a barrier, the SRS should not be discontinued.
3. SRS shall not be installed on bridge decks, overpasses or other concrete surfaces.

MoT Section	650	TAC Section	2.2.4.3
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### Figure 650.E Typical Paint Marking for SRS

To inform cyclists at the beginning of Shoulder Rumble Strips, three white lines shall be painted approximately 5.0 metres in front of the first milled rumble strip. The length of the lines shall be approximately 300 mm, the width shall be approximately 150 mm and the spacing shall be approximately 150 mm. The 3 white lines shall be painted at:

- the beginning of SRS where numbered routes cross and/or at major signalized intersections
- the beginning of SRS after an interruption of more than 1 km
- the beginning of SRS installed along an isolated section of road.



MoT Section	650	TAC Section	2.2.4.3
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## 650.02 Centreline Rumble Strips

### Background

Centreline Rumble Strips (CRS) have started being used by an increasing number of highway agencies over the last few years. CRS are used as a means to counter the frequency of crossover centreline crashes due to driver fatigue, inattention, error and/or impairment. Early studies have shown noteworthy safety improvements.

### Considerations

Centreline Rumble Strips should be considered on undivided, rural two-lane, three-lane, or four-lane highways in no passing zones (i.e. a double solid painted centreline) in the following cases:

1. New undivided, rural two-lane, three-lane, or four-lane highway sections;
2. When re-paving, rehabilitating or reconstructing existing undivided, rural two-lane, three-lane, or four-lane highway sections;
3. Other undivided, rural two-lane, three-lane, or four-lane highway sections that are not part of a project but would benefit from the installation of CRS in terms of decreasing the number of crossover centreline crashes. To assist Regions, a prioritized list of highway corridors prone to crossover crashes is available from HQ Engineering Branch, which identifies possible candidate locations; however, it does not limit CRS to only those locations. Funding and other resources for these stand-alone CRS projects are subject to availability and should be considered in the larger context of all safety initiatives.

CRS should not be used in urban areas. Good indications of urban highway sections are:

1. Speed Zone of 70 km/h or less in the vicinity of a settlement;
2. Highway section with curb and gutter or a sidewalk;
3. The average driveway spacing is less than 150 metres and intersection spacing is less than 500 metres.

The minimum centreline depth of pavement required is 50 mm. CRS are not to be installed if pavement deterioration or cracking is evident. Pavement should be in sufficiently good condition to accept the milling process without ravelling or deteriorating, otherwise the pavement should be upgraded prior to milling centreline rumble strips.

CRS are not to be installed if pavement is to be overlaid within 3 years.

Milling of CRS should be coordinated with traffic line painting operations to avoid milling newly applied traffic lines and to ensure that new yellow centrelines are installed within a short period of time after completion of the milling of the centreline rumble strips.

All projects that involve CRS should be submitted for ICBC Cost-Sharing evaluation.

### Application Guidelines

The layout for Milled-in CRS is shown in Figure 650.F.

CRS should be installed on the centreline, for undivided, rural two-lane, three-lane, or four-lane highways in no passing zones.

For application of CRS on lane widths less than 3.4 m, an engineering review is required.

On rural two-lane, three-lane, or four-lane undivided highways, CRS should be installed in the following manner:

- a) 300 mm CRS installed over the double solid painted centreline.
- b) CRS installation shall begin at the start of the double solid painted centreline.

On highways with a painted flush median, CRS should be installed in the following manner:

- a) For painted flush median < 2.0 m – apply CRS in the centre of the painted median;
- b) For painted flush median ≥ 2.0 m – refer to Section 650.02 and follow application guidelines for continuous Shoulder Rumble Strips.

MoT Section	650		TAC Section	2.2.4.3
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**CRS Interruptions**

CRS are to be interrupted prior to intersections, as shown in Figure 650.G.

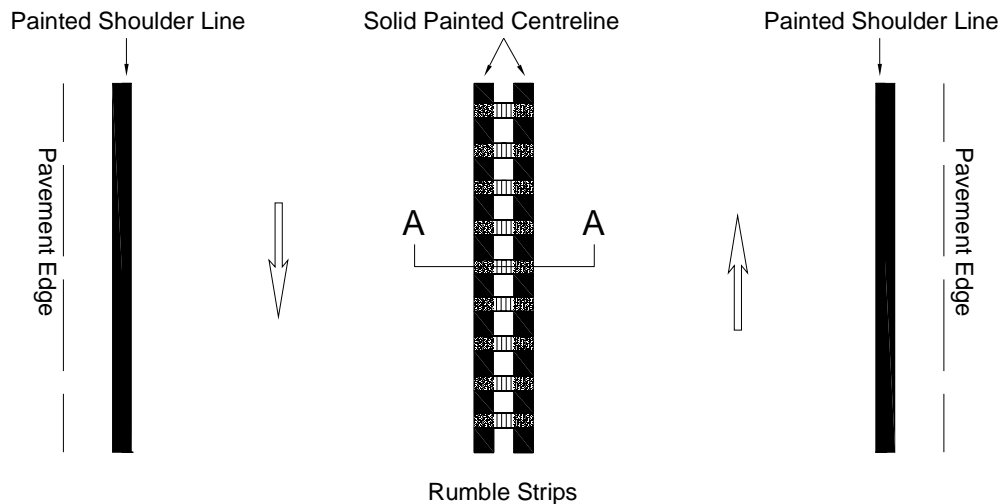
CRS are to be interrupted prior to commercial and residential entrances, as shown in Figure 650.H.

CRS shall not be installed on bridge decks, overpasses or other concrete surface structures, as shown in Figure 650.H.

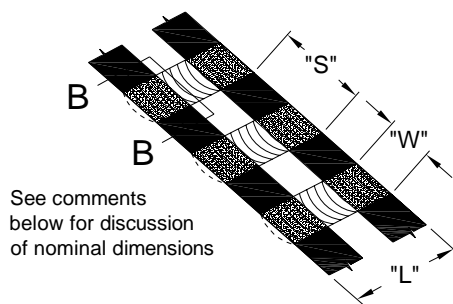
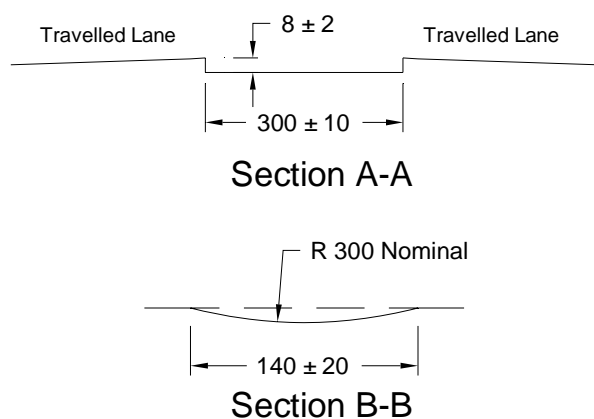
CRS should be discontinued within 200 m of a residential or urban area.

The minimum length of any individual section of CRS shall be 160 m.

MoT Section	650	TAC Section	2.2.4.3
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**Figure 650.F Milled Centreline Rumble Strips**

**NOTE:** ALL MEASUREMENTS SHOWN IN MILLIMETRES.



See comments  
below for discussion  
of nominal dimensions

### General Isometric View

Length of Rumble Strip "L" is 300 mm ± 10 mm.

Width "W" is nominally 140 mm ± 20 mm, based on the tolerance of the cut depth (8 mm ± 2 mm).

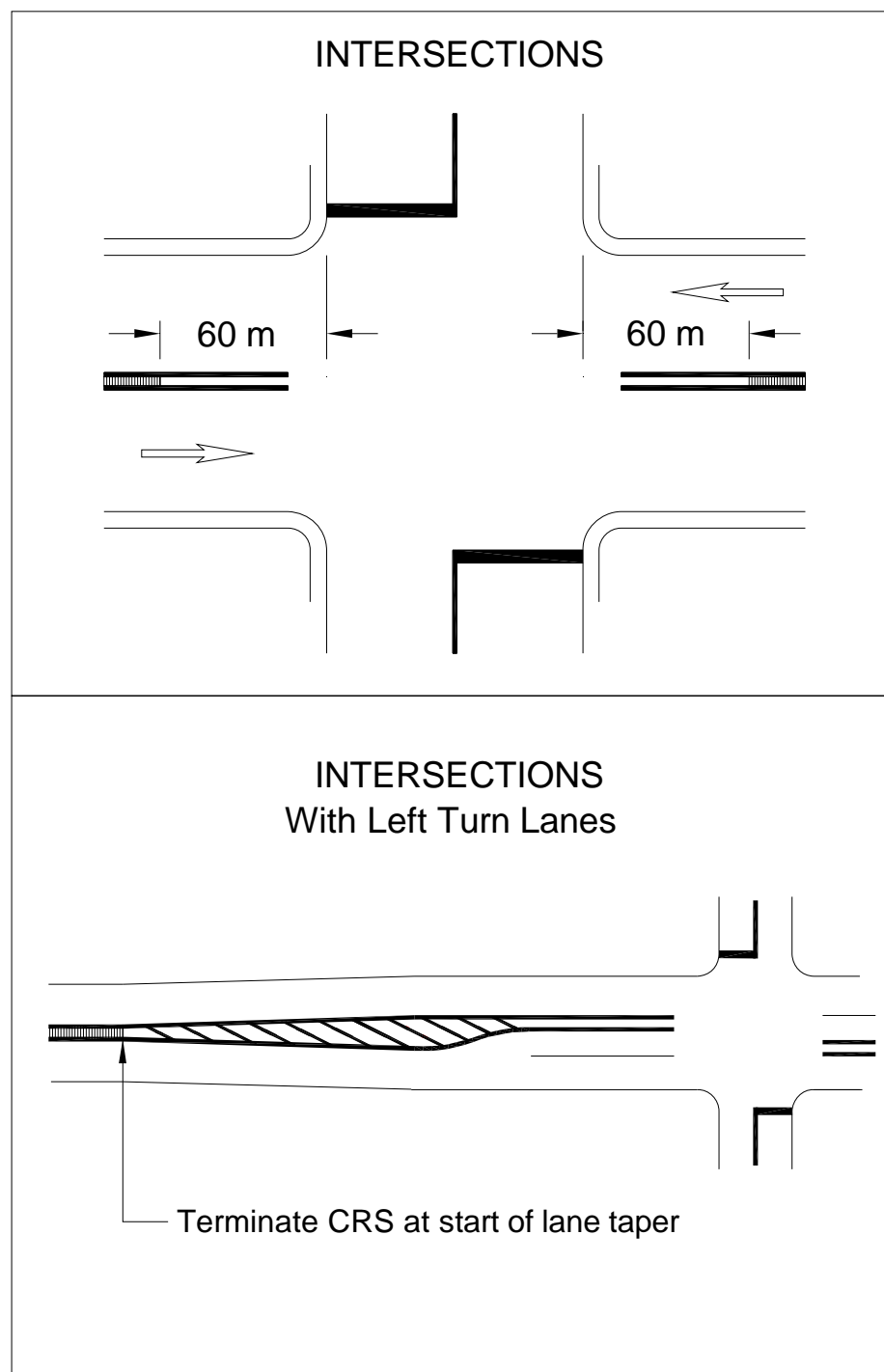
Spacing "S" between strips is 300 mm.

Lateral tolerance is ± 10 mm left or right of the outside edge of the paintlines.

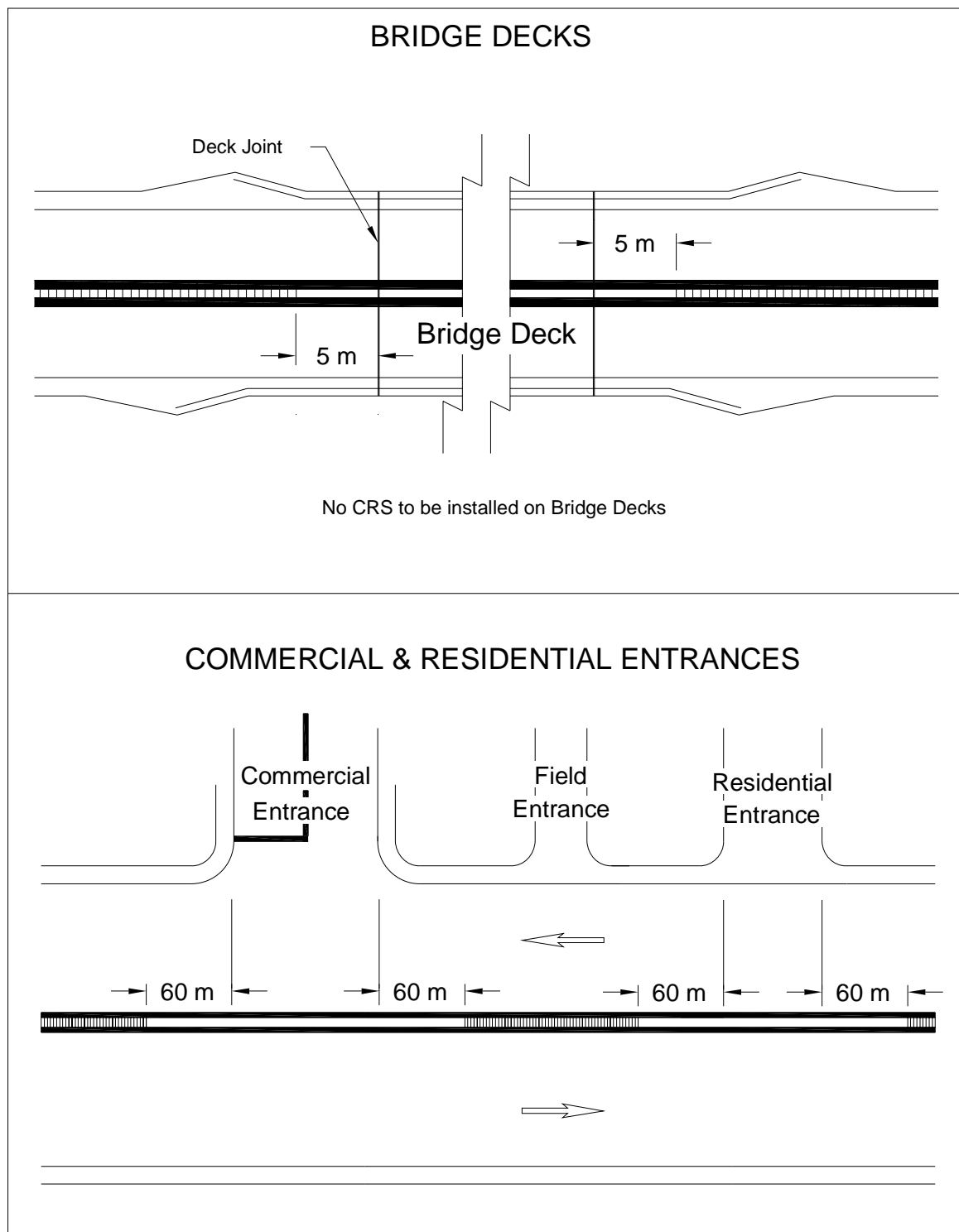
#### NOTES:

1. Milled-in CRS are to be placed on new and existing paved 2-Lane, 3-Lane, or 4-Lane undivided rural highways in No Passing Zones.
2. Milled-in CRS are not to be placed through urban areas.
3. Milled-in CRS are to be discontinued across private accesses and public road intersections. Refer to Figure 650.H.
4. CRS are to be discontinued in advance of all bridges. Refer to Figure 650.H.
5. For new pavement, milling shall only be done after line spotting but prior to the installation of new centreline pavement markings.

MoT Section	650		TAC Section	2.2.4.3
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**Figure 650.G CRS Interruptions at Intersections**

MoT Section	650		TAC Section	2.2.4.3
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**Figure 650.H CRS Interruptions at Bridge Decks and Accesses**



MoT Section	660	TAC Section	Not Applicable
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## 660 FENCING FOR PEDESTRIANS AND CYCLISTS

### 660.01 BACKGROUND

The Ministry of Transportation has adopted a policy for the consideration of pedestrians and cyclists for works within the highway right-of-way.

The primary objective of the policy is to ensure that adequate care is provided for the safety of pedestrians and cyclists when planning, designing and project managing works within the highway right-of-way.

### 660.02 APPLICATION DOMAIN

These guidelines are for all construction work, other than pavement re-surfacing work, within the right-of-way of highways under Ministry of Transportation jurisdiction, whether it is carried out by the Ministry, a utility provider, a developer, a private property owner, or under a partnership agreement.

### 660.03 DEFINITION

The following section describes physical roadside environments within the right-of-way which could be hazardous to pedestrians and cyclists. An

assessment of the need for fencing requires an evaluation of the both the nature of the hazard and the frequency of its exposure to pedestrians and cyclists. The frequency of exposure is a function of the location of the hazard and the volume of pedestrian and bicycle traffic nearby.

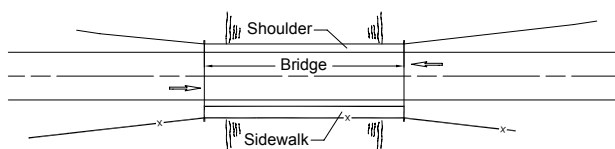
There are no definitive guidelines to determine what constitute significant numbers of pedestrians and bicycles. The designer should consult with the Ministry's Regional Traffic Engineer to determine whether and where there is significant pedestrian and bicycle traffic in the vicinity of the highway construction project.

### 660.04 APPLICATION AND INSTALLATION INSTRUCTIONS

The fence should be placed as far away as practicable from the traffic lanes or on top of a guardrail. The following figures and guidelines show and describe situations that can be construed as hazards requiring the installation of pedestrian or bicycle fencing.

#### Situation A

**Figure 660.A Fencing on a Bridge**



#### Description

Figure 660.A shows a bridge with a sidewalk and shoulder bikeway.

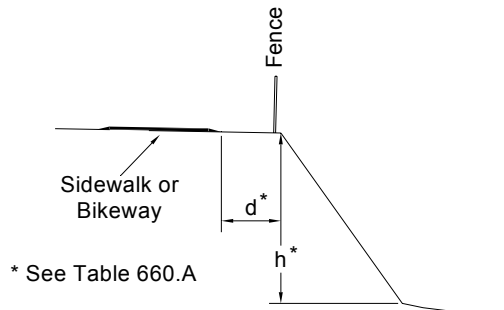
#### Guidelines

- Use the Standard Steel Sidewalk Fence (Bridge Dwg. 2891 - 1) along the edge of the sidewalk on the side of the water, ditch or gully.
- Use the Standard Steel Bicycle Fence (Bridge Dwg. 2891 - 2) when a significant number of cyclists use the sidewalk or if there is no sidewalk and a significant volume of cyclists use the bridge.
- Extend fence past the bridge abutments only if required as per Table 660.A and as shown in Figures 660.B and 660.C.

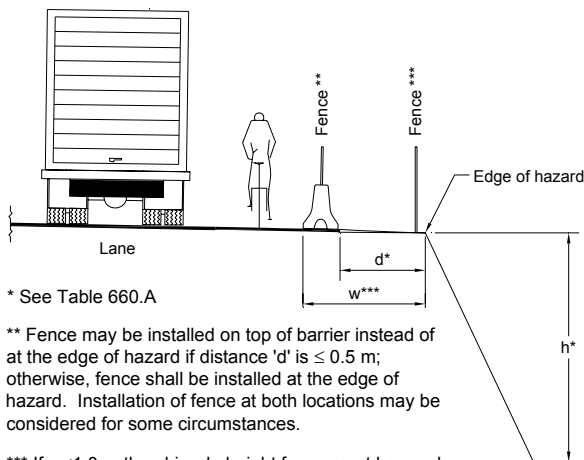
MoT Section	660	TAC Section	Not Applicable
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### Situation B

**Figure 660.B Fencing on a Fill Slope**



**Figure 660.C Fencing Near a Steep Drop**



\*\* Fence may be installed on top of barrier instead of at the edge of hazard if distance 'd' is  $\leq 0.5$  m; otherwise, fence shall be installed at the edge of hazard. Installation of fence at both locations may be considered for some circumstances.

\*\*\* If  $w < 1.0$  m then bicycle height fence must be used.

### Description

A constructed fill slope or original ground steeper than 1.5:1, a vertical drop or a structure such as a retaining wall or culvert within the right-of-way. This does not apply to most slopes adjacent to highway ditches which are 1.5:1 or flatter. Fencing is used when these hazards are:

- close to a sidewalk, bikeway, or trail, as illustrated in Figures 660.B and 660.C, known to be frequently used by pedestrians or cyclists (refer to preceding section 660.03), or
- close to a roadway; and
- for both of the above cases, when the height of the hazard meets the warrant in Table 660.A.

In these cases, the fence is required only when the sidewalk, bikeway, trail or edge of roadway pavement is located on the high side of the slope, drop or structure.

**Table 660.A Hazard Warrant for Installing Fence**

Distance from the outside edge of sidewalk, bikeway, trail or pavement: d (m)	Height of drop h (m)
$d < 1.0$	$\geq 0.5$
$1.0 \leq d < 2.0$	$\geq 1.0$
$2.0 \leq d < 3.0$	$\geq 2.0$
$d \geq 3.0$	$\geq 3.0$

### Guidelines

Use one of the following protections between the public and the hazard; according to the situation:

- the Sidewalk Fence (drawing SP741-07.01 in the Ministry "Standard Specifications for Highway Construction") at the edge of a sidewalk or trail on the high side of the hazard;

MoT Section	660	TAC Section	Not Applicable
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### Guidelines (continued for Situation B)

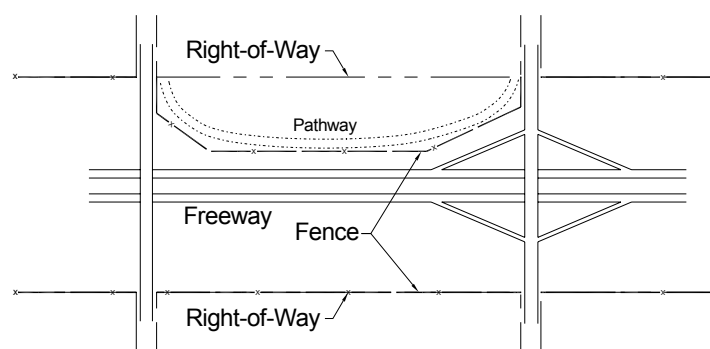
- the Sidewalk Fence (SP741-07.01) to a height of 1.4 metres at the edge of a bikeway (or sidewalk or trail used by cyclists) on the high side of the hazard;
- the concrete roadside barrier with rails and posts fastened on top of the barrier to make it conform in height to the sidewalk fence or the bicycle fence;
- fencing as per the current Ministry "Standard Specifications for Highway Construction" - Type B, Standard Wire Fabric Fence or Type D, Chain Link Fence. In this case, the fence should be installed in a location which would prevent pedestrians and cyclists access to the hazard. This is preferably, but not necessarily always, right against the top of the hazard. In some cases, fencing along the right-of-way or the

property line should be sufficient. For trails, fencing may be installed where it is most convenient between the trail and the hazard. Within the clear zone, use a fence that has frangible posts. If horizontal railings are used, they shall be designed such that they do not create a spearing hazard when impacted by a vehicle.

**Important note:** In locations where fencing is required and which are near a primary school or playground, or on a route used by children of primary school age or younger -- the vertical bars on the fence shall be spaced to a maximum of 150 mm for a height of at least 685 mm above the ground or sidewalk surface. For bikeways, the height required for the vertical bars spaced at 150 mm or less should be at least 985 mm.

### Situation C

**Figure 660.D Fencing Along a Pathway Inside Right-of-Way**



### Description

Along Freeways and Expressways as illustrated in Figure 660.D.

For urban and suburban freeways and expressways abutting residential subdivisions, commercial or industrial land, there is a need to separate the general population from the high speed traffic.

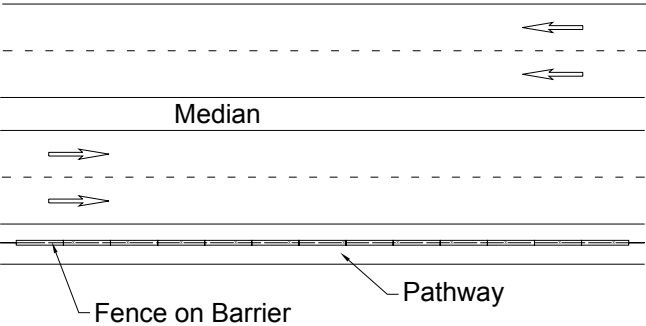
### Guidelines

Use fencing as per the current Ministry "Standard Specifications for Highway Construction" - Type B, Standard Wire Fabric Fence or Type D, Chain Link Fence along roadway stretches between interchanges and intersections. Fencing is installed along the right-of-way or, in cases where there is a pathway within the right-of-way, the fence should be between the pedestrian or bicycle pathway and the roadway, as far as practicable from the edge of the roadway. Within the clear zone, use a fence that has frangible posts. If horizontal railings are used, they shall be designed such that they do not create a spearing hazard when impacted by a vehicle.

MoT Section	660		TAC Section	Not Applicable
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Situation D

Figure 660.E Fencing Along a High Volume Highway



Description

On roadways and bridges with a bicycle path or sidewalk where the AADT > 35,000 or SADT > 40,000 and a posted speed ≥ 70 km/h as shown in Figure 660.E.

Guidelines

Use fencing when the separation between the edges of the outside travel lane and the bike path or sidewalk is less than 2.1 metres (including the shoulder width). (Note: If the outside roadway travel lane is wider than 3.6 metres, this offset requirement between the bike path or sidewalk and the lane may be decreased by the same amount that the roadway lane is in excess of 3.6 metres.)

Use fencing when and where it is necessary to deter pedestrians from crossing the roadway.

Use the standard Concrete Roadside Barrier (CRB SP941-01.02.01/02) on the side of the roadway, between the roadway and the sidewalk or bike path. Rails and posts should be installed on top of the barrier to make it conform to the sidewalk fence height for a sidewalk. The bicycle fence height is used when a significant number of cyclists use the sidewalk or if the CRB is adjacent to a bike path. If the pathway next to a barrier is used by cyclists and pedestrians, the minimum width from the edge of barrier to the outside edge of pavement should be:

- 2.5 m for one-way bicycle traffic
- 3.5 m for two-way bicycle traffic